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INVESTIGATION OF POSSIBLE RECHARGE SOURCES FOR SPRING 102 TRACT C-b, PICEANCE BASIN COLORADO

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24 September 1984

* THERMAL
EXPLORATION

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INTRODUCTION

Purpose of Investigation

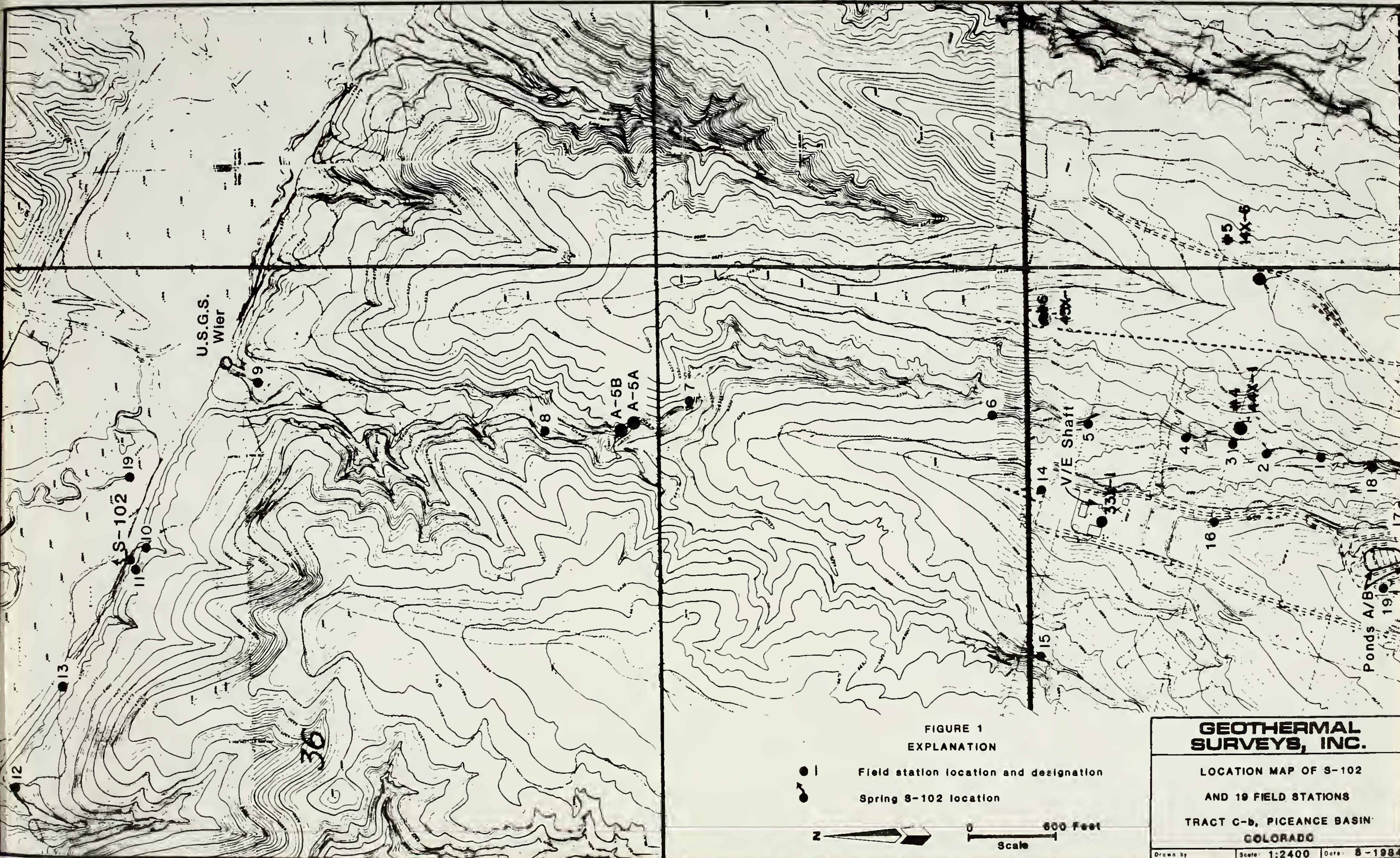
- Identify possible sources of the flow from Spring 102 (S-102), which also explain the increase in fluoride levels since January, 1981.
- Prioritize the likelihood of the potential sources.
- Make recommendations for testing the most likely hypotheses.

Description of Work

A geohydrologic reconnaissance was done 19, 20, 21 June, 1984. During this time, nineteen localities were visited and their geohydrologic features investigated and described. Figure 1 presents the localities. The field descriptions and photographs are provided in Appendix 1.

In addition, the Quaternary alluvium (Qal) - Uinta Formation contact was mapped and general geohydrologic observations were made in the vicinity of S-102 and No Name Gulch (Little Gardenhire Gulch).

The mapping and observations supplement the work of Beard (1983 and Duncan (1976).


U.S.G.S. Wier
S-102
A-5B
A-5A
V/E Shaft
Ponds A/B
14X-6
14X-1
1
2
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36
FIGURE 1
EXPLANATION
Field station location and designation
Spring S-102 location
0
600 Feet
Scale
GEOTHERMAL SURVEYS, INC.
LOCATION MAP OF S-102
AND 19 FIELD STATIONS
TRACT C-b, PICEANCE BASIN
COLORADO
Drawn by
Scale: 1:2400
Date: 8-1984

RESULTS OF GEOHYDROLOGIC MAPPING

The results of the geohydrologic mapping are presented in Figure 2.

Joint Characteristics

- Where observed in outcrop, the Unita Formation exhibts predominantly west-northwest and east-northeast primary joint trends. Secondary joints trend mostly northeast.

- A few of the small gullies appear to be joint controlled.

- Joint dips range from 12° to 86°, with an average dip of 60°.

- Joint density is dependent on lithology. Barren marlstones, shale and siltstone exhibit the greatest densities, sandstone beds show lower densities. For all lithologies, primary joint density ranges approximately between 1 and 4. Here density is defined as the number of joints with a 10 ft section perpendicular to the joint. At most localities visited, marlstones, shales and siltstones are very fissile.

- Joint widths in outcrop vary greatly because of mechanical weathering. Widths range from less than 1/64 inch to 1/2 inch.

Geohydrologic Observations in S-102 Area

- S-102 is issuing from bedrock along and slightly topographically above the alluvial-bedrock contact. As reported by Beard (1983), the spring may be issuing from the marlstone unit, Tg_2, of the Green River Formation, although this was difficult to ascertain in the field because Tg_2 is poorly exposed. This suggests that Tg_2 is possibly closely fractured and a very permeable unit as indicated by Beard (1983).

- The Black Sulfur Creek tongue occurs topographically above the spring. At this locality, the Black

Sulfur Creek tongue exhibits open joints and fractures. This suggests that the Black Sulfur Creek tongue is locally permeable.

- S-102 occurs between the alluvial fans of two small gulches which bound S-102. Boggy conditions which exist at the toes of the alluvial fans may indicate shallow ground water flow from bedrock into the alluvium. This is supported by the existence of flowing conditions observed during the reconnaissance in the 1 inch diameter alluvial monitor well completed in Well A-102-1 (GSI, 1983, p.5).

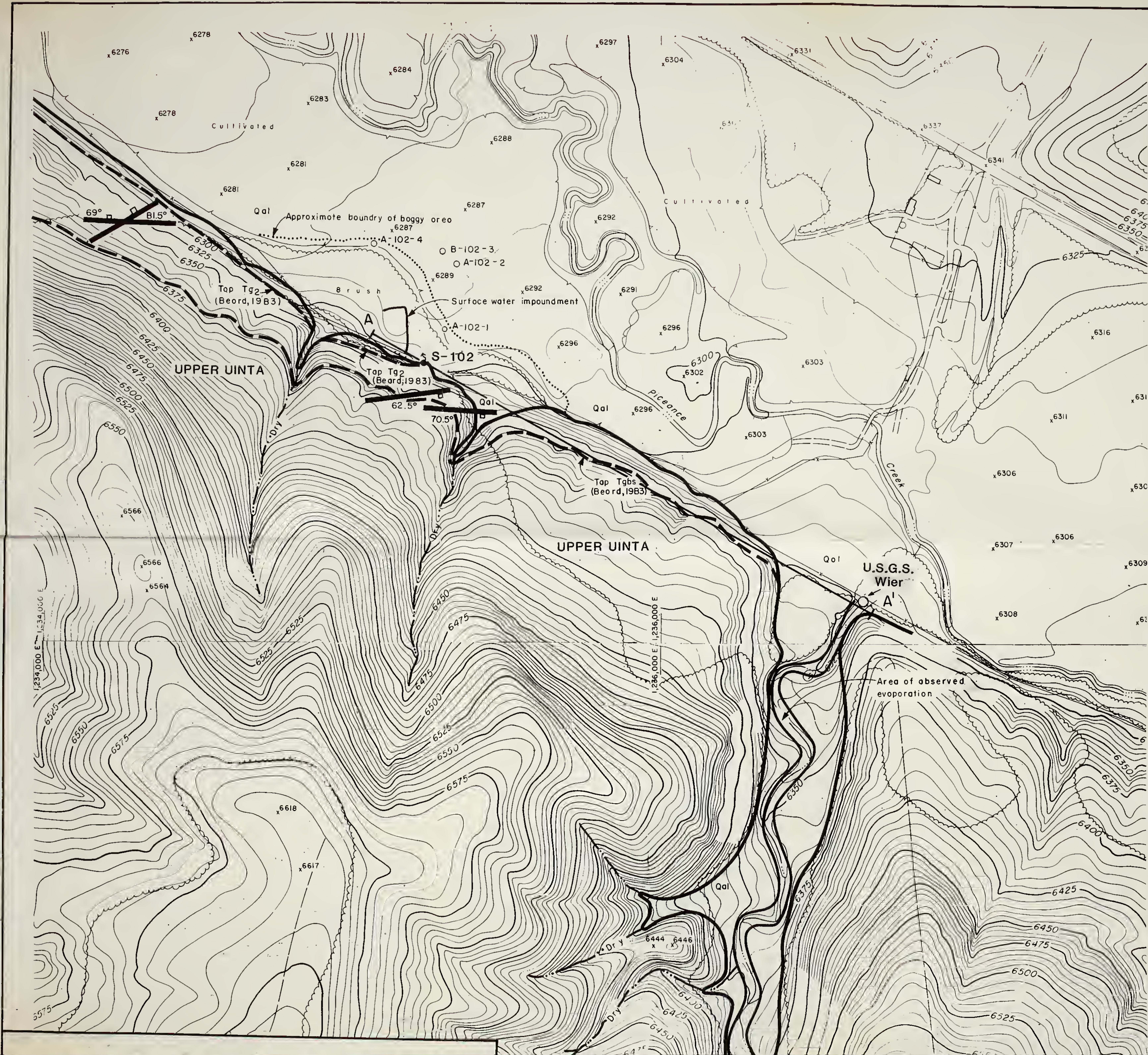
Geohydrologic Observations Along East No Name Gulch

- Between the NPDES discharge into East No Name Gulch and CB's flume in No Name Gulch just upstream from its confluence with Piceance Creek, the flow diminished from approximately 312 gpm to 94 gpm.

- Most of the flow appears to be lost to infiltration and evaporation downstream from Field Station 8 ((Figures 1, 2), where the volume of alluvium in the channel increases dramatically.

- Between the NPDES discharge point into East No Name Gulch and Field Station 8, flow is often in direct contact with open fractures and joints within the Uinta Formation (see Appendix 1, photograph nos. 3, 4, 9). Downstream from Station 8, the stream does not flow directly over bedrock.

- At Field Station 17, downslope and directly east of Ponds A/B, a spring issues from talus and weathered bedrock(?).



Cultivated
Qal
Approximate boundry of boggy area
A-102-4
B-102-3
A-102-2
Brush
Tap Tg2 (Beard, 1983)
Surface water impoundment
A-102-1
A
S-102
UPPER UINTA
Tap Tg2 (Beard, 1983)
69°
81.5°
62.5°
70.5°
Piceance
Creek
Tap Tgbs (Beard, 1983)
Dry
U.S.G.S. Wier
A'
1,234,000 E
1,236,000 E
Area of observed evaporation

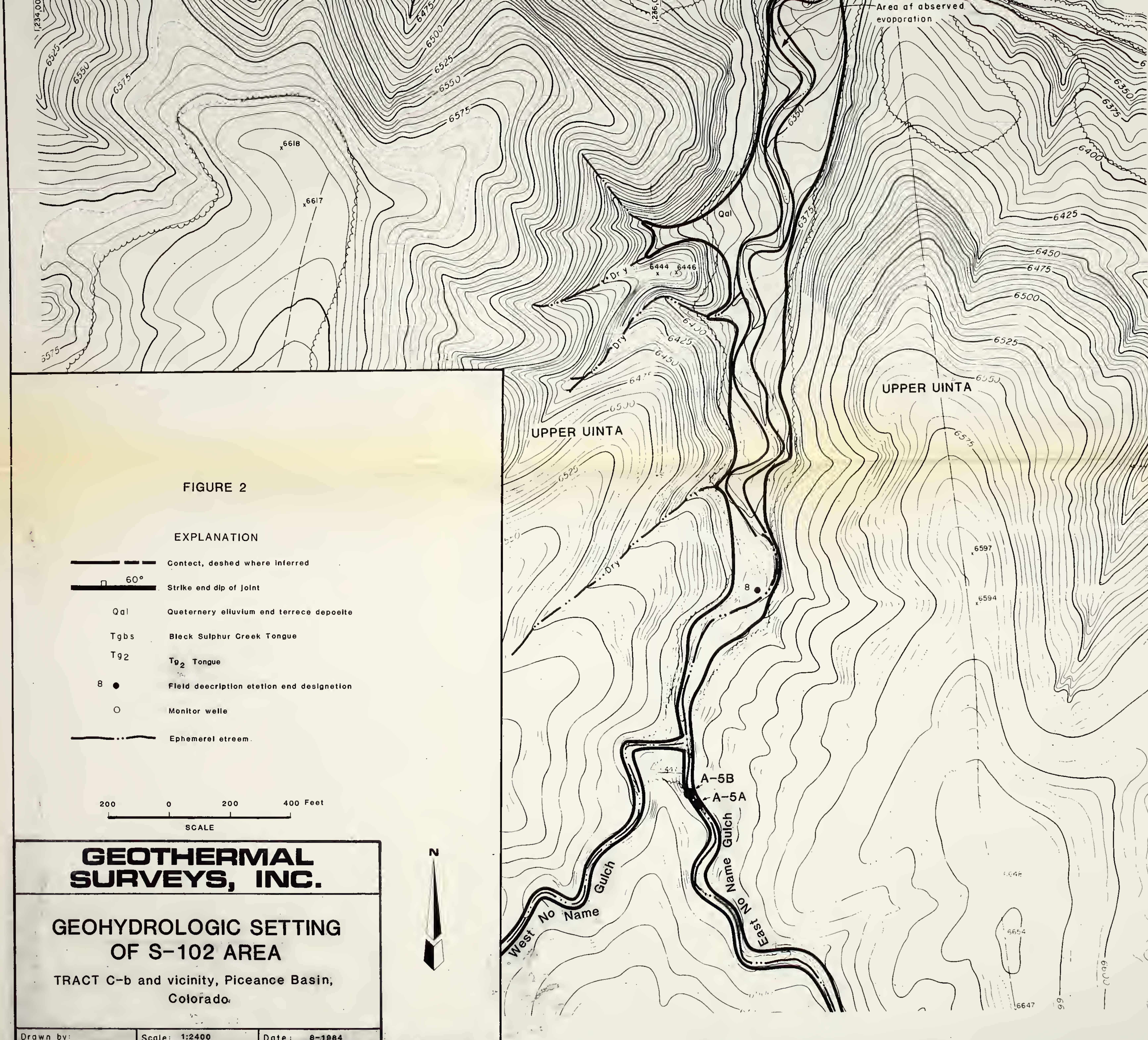


FIGURE 2

EXPLANATION

Contect, deshed where inferred

60° Strike end dip of joint

Qal Queternery eliuvium end terrece depoeite

Tgbs Bleck Sulphur Creek Tongue

Tg_2 Tg_2 Tongue

8 ● Field deecription etetion end designetion

○ Monitor welle

Ephemerel etreem

200 0 200 400 Feet

SCALE

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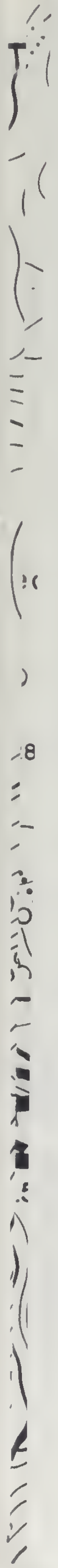
GEOHYDROLOGIC SETTING OF S-102 AREA

TRACT C-b and vicinity, Piceance Basin, Colorado

Drawn by:	Scale: 1:2400	Date: 8-1984



HYPOTHESES FOR POSSIBLE SOURCES OF RECHARGE

1. NPDES flow ino No Name Gulch
2. Infiltration from Ponds A/B
3. Pond C
4. V/E Shaft
5. Upwelling of deep aquifer ground water

HYPOTHESIS 1: Upper and Lower Uinta Ground Water Combined with Infiltration of NPDES Discharge Into East No Name Gulch

Description

NPDES discharge into East No Name Gulch enters the Upper Unita aquifer through open joints and fractures within the Uinta Formation exposed along the underlying alluvium within No Name Gulch. The effluent migrates north-northeast and mixes with fresher Upper Uinta ground water as it crosses the weathered Black Sulphur Creek tongue and discharges at S-102 and into Piceance Creek alluvium.

Figure 3 presents the elevation of Field Station 8 relative to S-102, which indicates that Field Station 8 is upgradient from S-102.

Figure 4 presents the time and fluoride concentration relationships for NPDES discharge into East No Name Gulch and S-102.

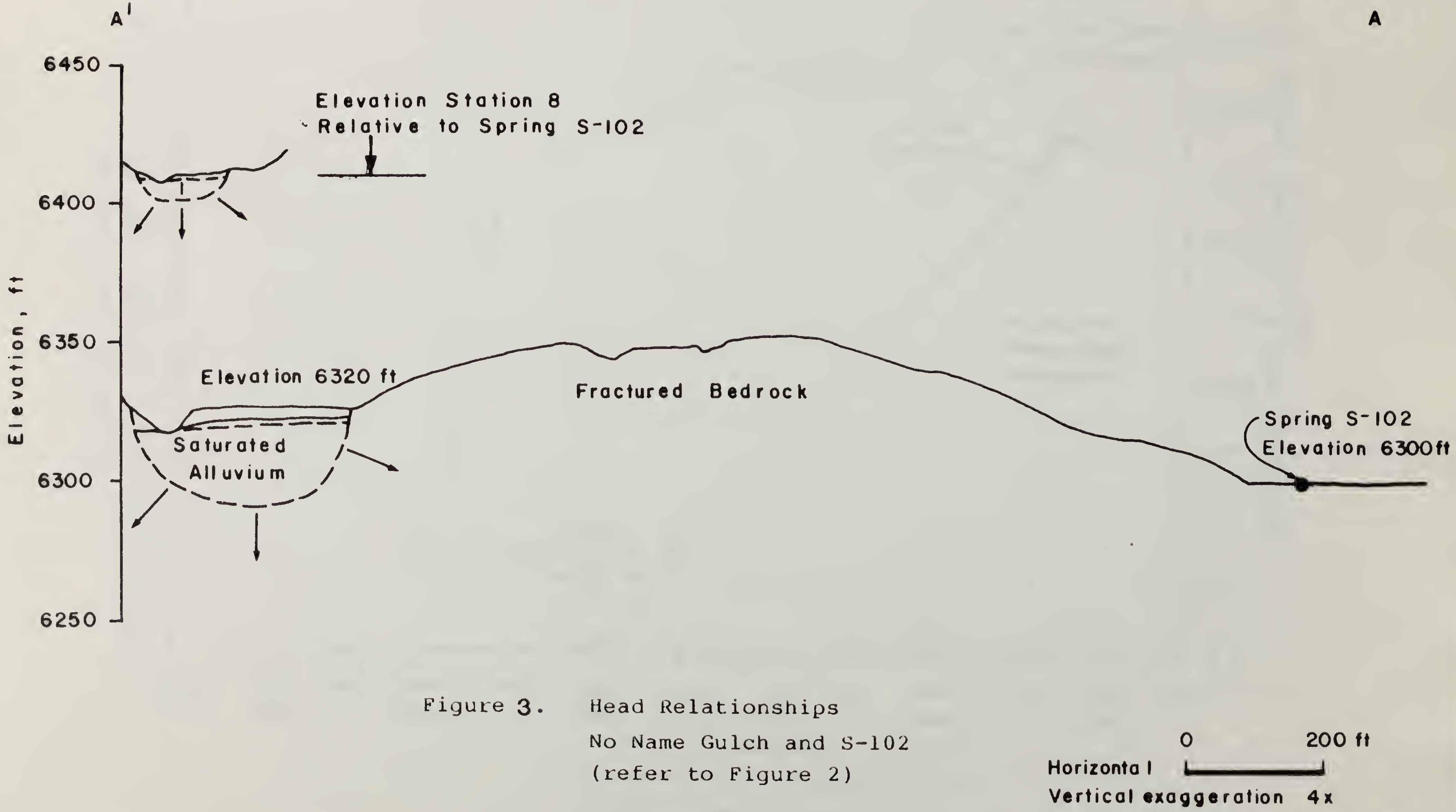


Figure 3. Head Relationships
No Name Gulch and S-102
(refer to Figure 2)

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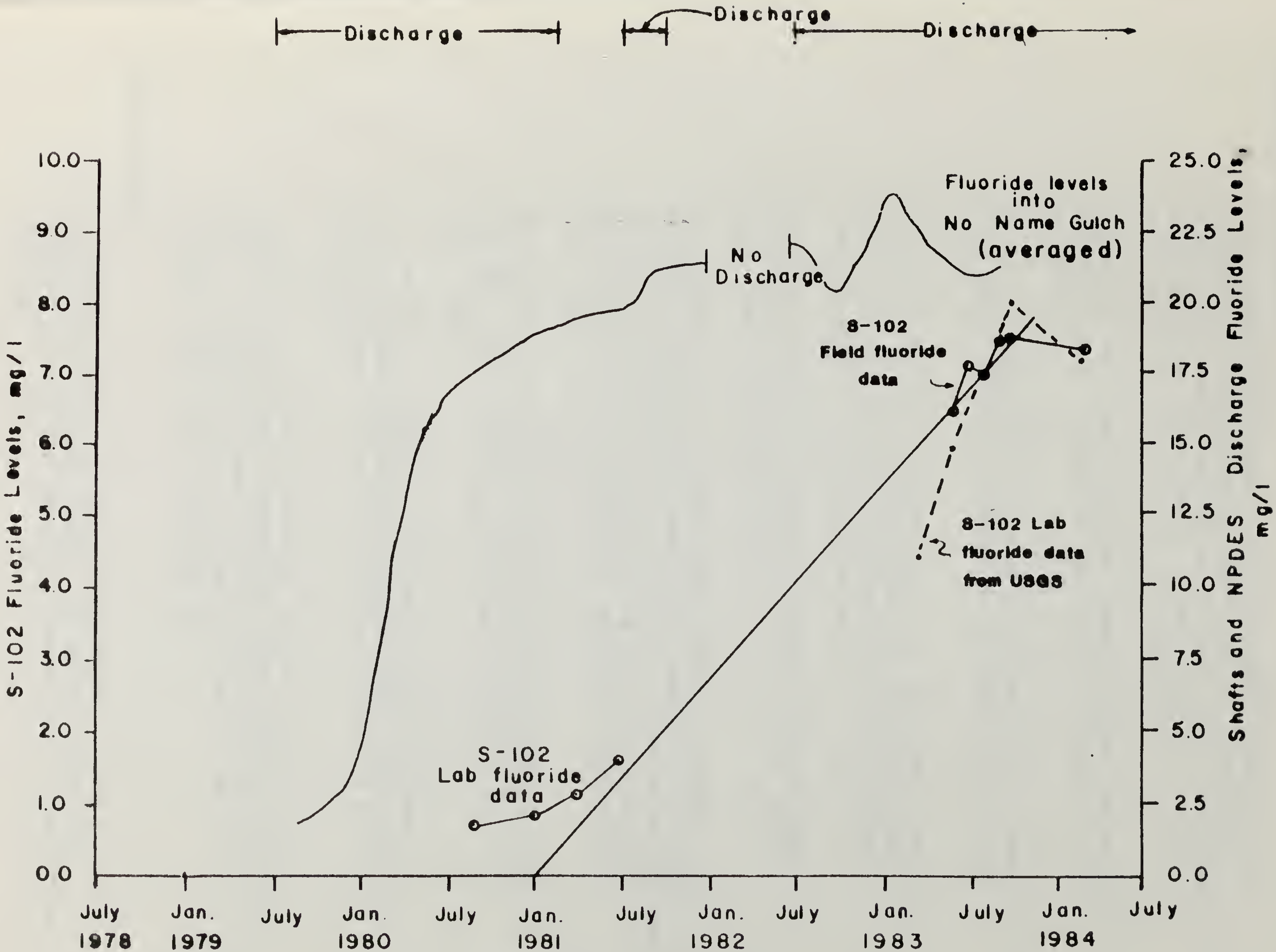

Figure 4. Time and Fluoride Concentration Relationships NPDES Discharge into East No Name Gulch and S-102

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Supporting Evidence

- The jointed, fractured and weathered character of the Upper Uinta along portions of No Name Gulch provide a permeable medium through which infiltration and migration can occur. (See Appendix 1, photograph nos. 3, 4, 5, 6, 7, 8, 11-14, 17).

- Exposures of Black Sulphur Creek tongue are weathered and show open fractures and joints in the vicinity of S-102.

- S-102 is topographically and hydraulically downgradient from most of the streambed of No Name Gulch (see Figure 3).

- The flow within No Name Gulch is in direct contact with open joints and fractures within the Upper Uinta, particularly upstream from Field Station 8 (see Appendix 1, photograph nos. 3, 4, 9).

- Fluoride levels of NPDES discharge into No Name Gulch have averaged roughly 15 to 20 mg/l since early 1980 (see Figure 4).

- Flow measurement between the NPDES discharge point and CB's flume in No Name Gulch immediately upgradient from its confluence with Piceance Creek were observed to drop off from 312 gpm to 94 gpm, respectively. Most of the flow appears to diminish downstream from Field Station 8.

- Discharge into No Name Gulch has averaged roughly 400 gpm since August, 1979, with exception of an interval of no discharge between August, 1981 and July, 1982.

- A time lag of roughly 480 days exists between initial NPDES discharge into No Name Gulch and the first apparent rise in fluoride levels in S-102 (Figure 4).

- Fluoride in bedrock seepage monitor well A-5B (41X-1) have been increasing since NPDES discharge began in East No Name Gulch. The fluoride concentration in the saturated shallow bedrock was 13 mg/l in October, 1981 (see Appendix 5).

Deficiencies

- An apparent deficiency at this time is the lack of increased flow from S-102. However, with this concept, there are several flow outlets in addition to S-102.

Independent Test

- As an independent test of this hypothesis, the hydraulic conductivity (K) of the Upper Uinta was estimated based on various elements of the supporting evidence. The results range between 3.1 and 47.5 ft/day. These hydraulic conductivity values characterize "clean sandstone and fractured igneous and metamorphic rock" (U.S. Department of the Interior, 1981, p.29) and are, therefore, considered reasonable. Hydraulic conductivity calculations for No Name Gulch are provided in Appendix 2.

HYPOTHESIS 2: Upper and Lower Uinta Ground Water Combined with Infiltration from Ponds A/B

Description

Leakage from Ponds A/B infiltrates into the Upper Uinta aquifer through joints and fractures. Ponds A/B water then migrates north where it crosses the locally weathered and jointed Black Sulphur Creek tongue, mixes with Lower Uinta ground water and discharges at S-102 and into Piceance Creek alluvium.

Figure 5 presents an idealized diagram of the geohydrologic implications of this hypothesis.

Figure 6 highlights time relationships between Ponds A/B activity and changes in fluoride levels for S-102.

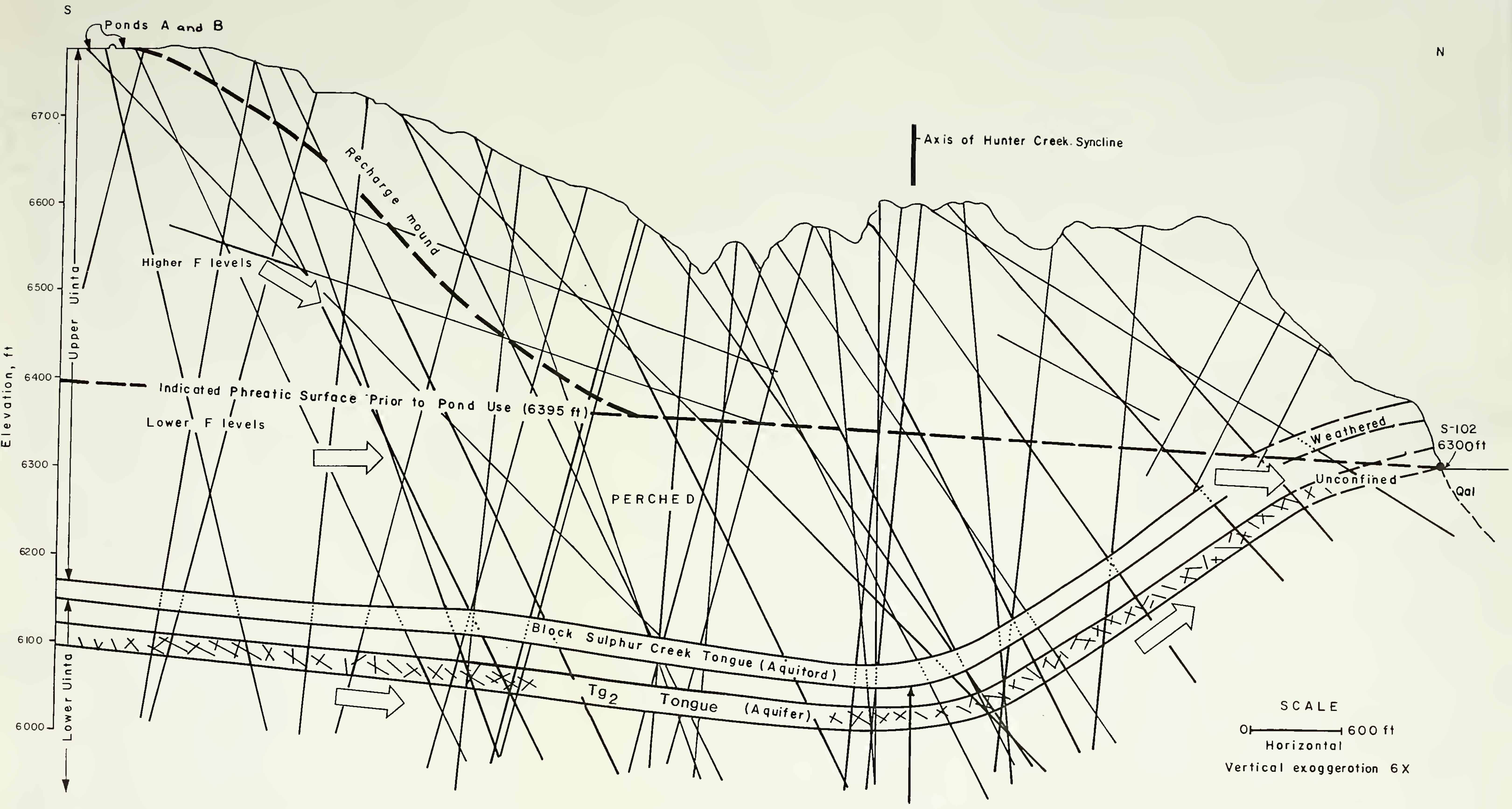

Figure 5. Diagrammatic Geohydrologic
Cross Section
Ponds A and B to S-102

Dips of joints are not corrected for difference between horizontal and vertical scales
Geology from (Beard, 1983, plate 1; Duncan, 1976)

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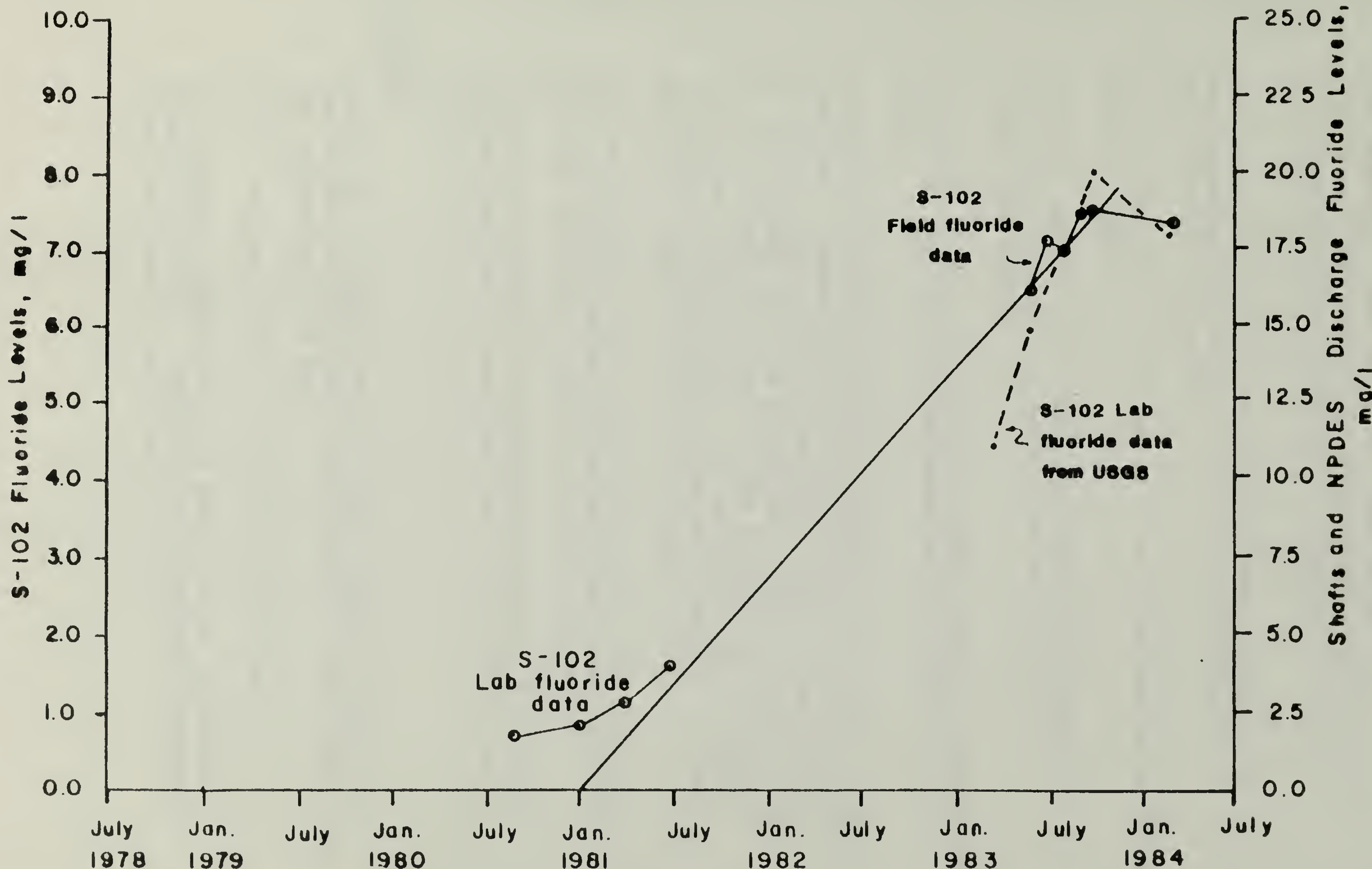

Figure 6. Time Relationships Between Ponds A and B Use and Changes in S-102 Fluoride Levels

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Supporting Evidence

- The jointed, fractured and weathered character of the Upper Uinta provides a permeable medium for infiltration (see Appendix 1, photograph nos. 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 17).

- Exposures of the Black Sulfur Creek tongue are weathered and show open fractures and joints in the vicinity of S-102.

- Ponds A/B were not lined with an impermeable material prior to use.

- Settled solids have been periodically cleaned from the ponds thereby allowing the pond bottom to remain permeable.

- Fluoride levels in Ponds A/B have averaged approximately 15 to 20 mg/l since the ponds were filled in early 1979.

- Indicated evaporation and leakage since July, 1982 (earlier losses from Ponds A/B could not be differentiated from those in Pond C) ffrom Ponds A/B is on the order of 2.38 ac-ft/mo. This, in part, may be attributed to loss to the spring east of Ponds A/B (Field Station 17). Flow metering of NPDES discharge is reportedly accurate (Mr. G. Ullinskey, personal communication, 29 August 1984).

- A time lag of roughly 660 days exists between the time the ponds were filled and the first apparent rise in fluoride levels in S-102 (Figure 6).

- S-102 has reached an apparent plateau in fluoride concentrations, consistant with those measured in Ponds A/B.

Deficiencies

- Ponds A/B seepage monitor well (31X-12 (WW22)) has shown consistantly low fluoride concentrations, not exceeding 1.6 mg/l.

- 44X-1 was reportedly dry during drilling.

- An apparent deficiency is the lack of increase in flow from S-102. However, this concept proposes other outlets in addition to S-102.

Independent Test

As independent test of this hypothesis, the hydraulic conductivity (K) was estimated based on the supporting evidence. The result provides a range between 2.8 and 28.2 ft/day. These values typically characterize "clean sandstone and fractured igneous and metamorphic rock" (U.S. Department of the Interior, 1981, p.29) and, therefore, are considered reasonable. Hydraulic conductivity calculations and assumptions used to test Hypothesis 2 are provided in Appendix 3.

HYPOTHESIS 3: Upper and Lower Uinta Ground Water Combined with Infiltration from Pond C

Description

Leakage from Pond C, during its use, entered the Upper Uinta aquifer through joints and fractures and migrated north where it presently crosses weathered Black Sulfur Creek tongue, mixes with Lower Uinta ground water and discharges at S-102 and into Piceance Creek alluvium.

Figure 7 presents the time and fluoride concentration relationships between Pond C and S-102.

HYPOTHESIS 3: Upper and Lower Uinta Ground Water Combined with Infiltration from Pond C

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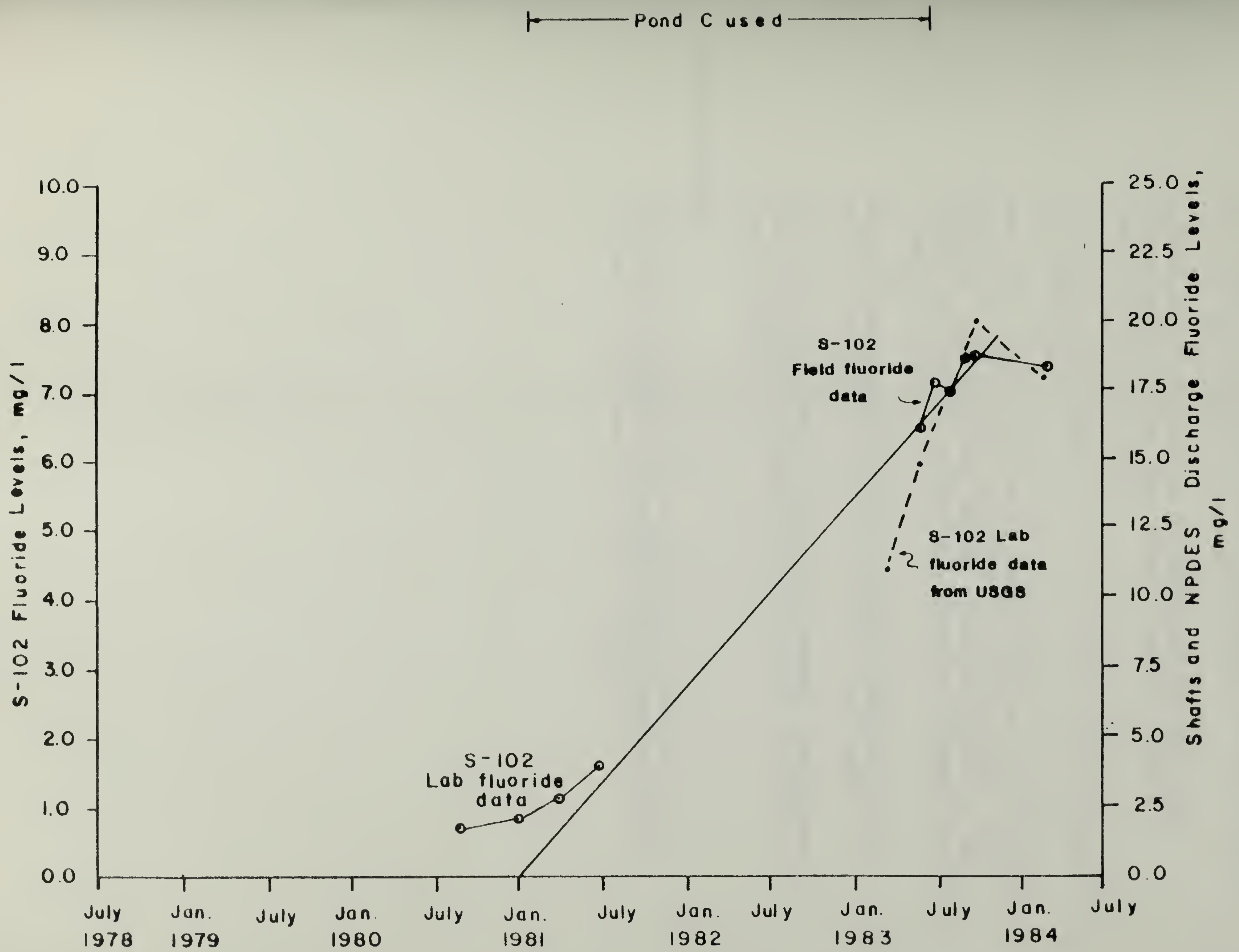

Figure 7. Time and Fluoride Concentration Relationships Pond C and S-102

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Supporting Evidence

- The jointed, fractured and weathered character of the Upper Uinta provides a permeable medium through which fluid migration can occur.

- Exposures of the Black Sulfur Creek tongue are weathered and show open fractures and joints in the vicinity of S-102.

- S-102 is topographically and hydraulically downgradient from Pond C.

- 444.5 ac-ft of mine water evaporated or infiltrated from Pond C between February, 1981 and July, 1983. Some of this loss may be ascribed to error in the Badger Meters (G. Ullinskey, personal communication, 29 August 1984).

- Water levels within 41X-13 (Pond C monitor) rose during the period which the Pond C was used.

- Well 41X-13 showed a downhole thermal configuration which suggested downward fluid migration during use of Pond C.

Deficiencies

- The initial impact in S-102, as suggested by an increase fluoride concentrations, occurred prior to the initial use of Pond C (Figure 7).

HYPOTHESIS 4: Leakage of Mine Water Upwelling Within the V/E Shaft into the Upper Uinta

Description

Since the V/E Shaft was allowed to flood in September, 1981, deep aquifer water has upwelled within the V/E Shaft and leaked into the Upper Uinta. The mine water migrates north to S-102, where it is discharged.

Figure 8 shows the time relationships between V/E Shaft construction, pumping and fluoride levels with fluoride levels in S-102.

Figure 9 presents relationships between depth-fluoride concentration relationships within the V/E Shaft on August 2, 1982, and the range of fluoride levels measured in S-102 between June, 1982 and March, 1984.

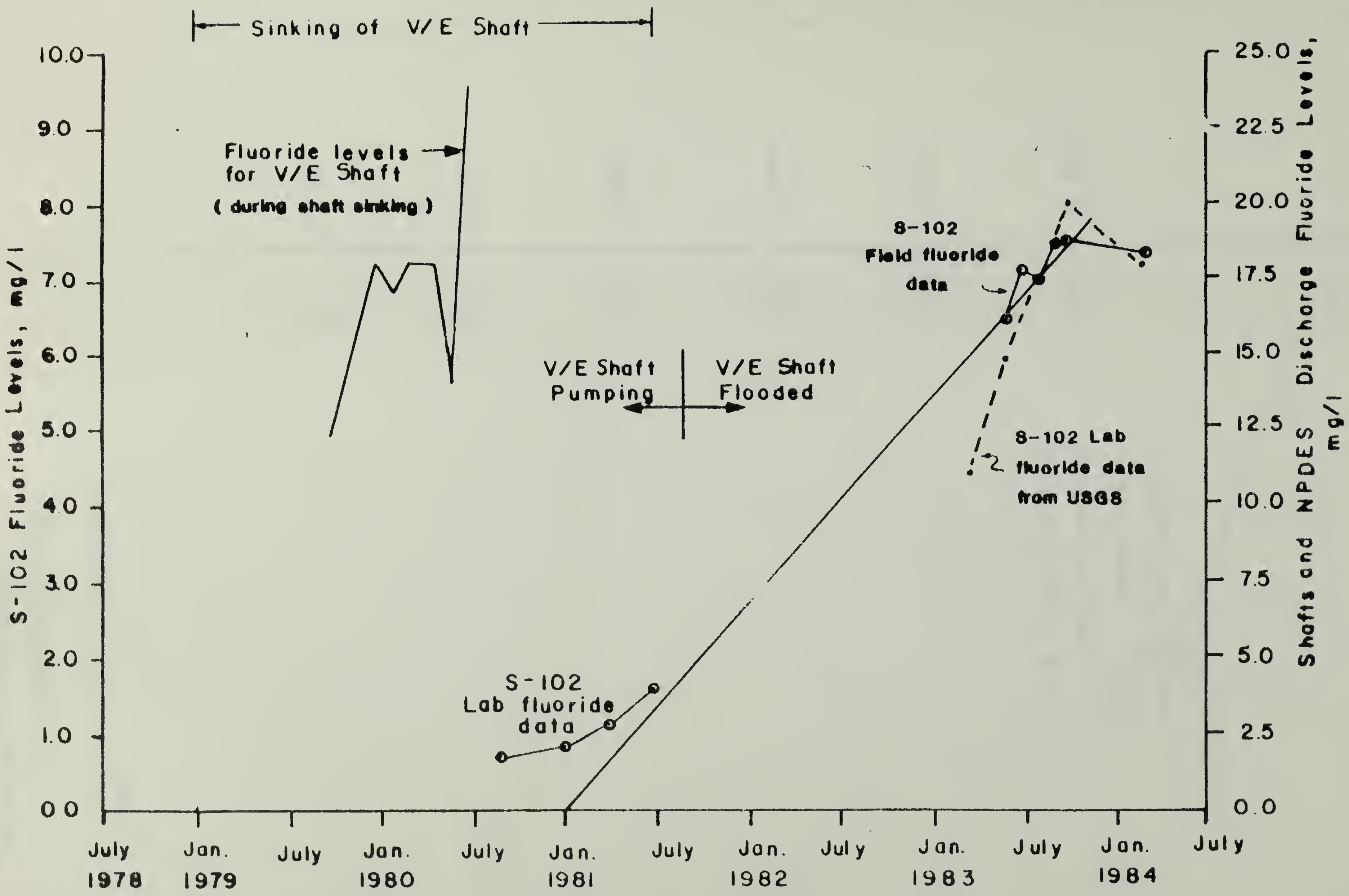

Figure 8. Time Relationships Between V/E Shaft Activities and S-102 Fluoride Levels

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Figure 9. Fluoride Relationships
V/E Shaft and S-102

Horizontal: 0 600 ft

Vertical exaggeration 3X

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Supporting Evidence

- The static water level within the V/E Shaft has been above an elevation of 6300 ft on a few occasions since flooding, thus these levels may be temporarily hydraulically upgradient from S-102.

Deficiencies

- Since the V/E Shaft was flooded, water levels within the shaft have been mostly at and slightly below an elevation of 6300 ft.

- The V/E Shaft was flooded after the initial rise in fluoride levels for S-102 (Figure 8).

- Down-the-shaft fluoride concentration measurements indicate that fluoride concentrations do not exceed 5.40 mg/l above an elevation of 5205 ft. The values are well below S-102 fluoride measurements (Figure 9).

HYPOTHESIS 5: Upwelling of Deep Aquifer Water

Description

Ground water from deeper aquifers (LPC , LPC , UPC and UPC) flows upward, mixes with Lower and, possibly, Upper Uinta ground water and discharges into the alluvium of Piceance Creek and at S-102.

Figure 10 presents the water level in SG-20 while the V/E Shaft was being pumped.

Figure 11 presents time relationships between changes in water surface elevations in SG-20 to changes in flow in S-102 prior to, during and after the flooding of the V/E Shaft.

Figure 12 compares the mean temperature as well as the standard deviation and range for S-102 to the expected temperature at S-102, if upwelling from deeper aquifers is occurring.

Figure 13 shows the relationship between calculated radiometric ages of deep aquifer water and the first occurrence of fluoride level rises in S-102, based on available data.

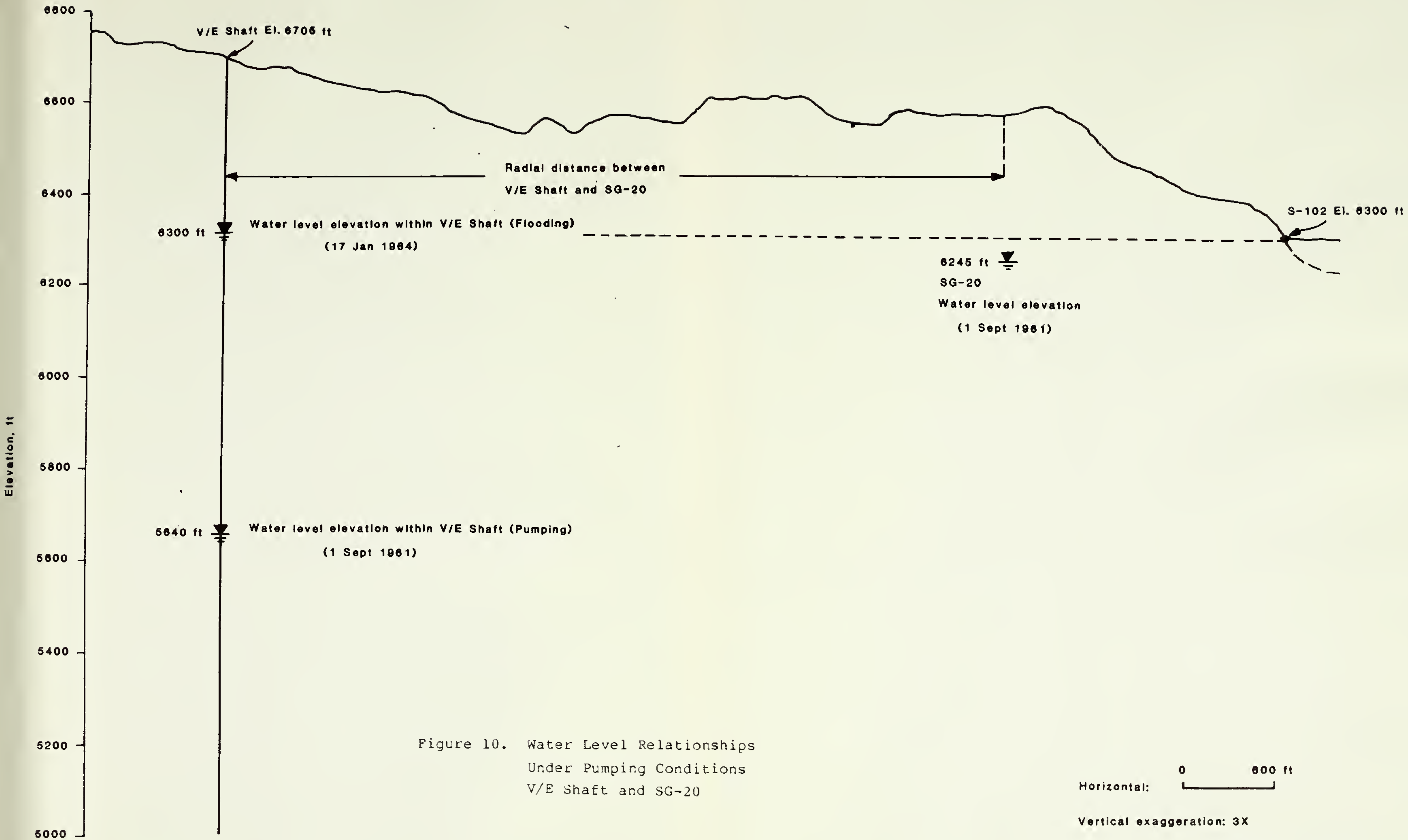

Figure 10. Water Level Relationships
Under Pumping Conditions
V/E Shaft and SG-20

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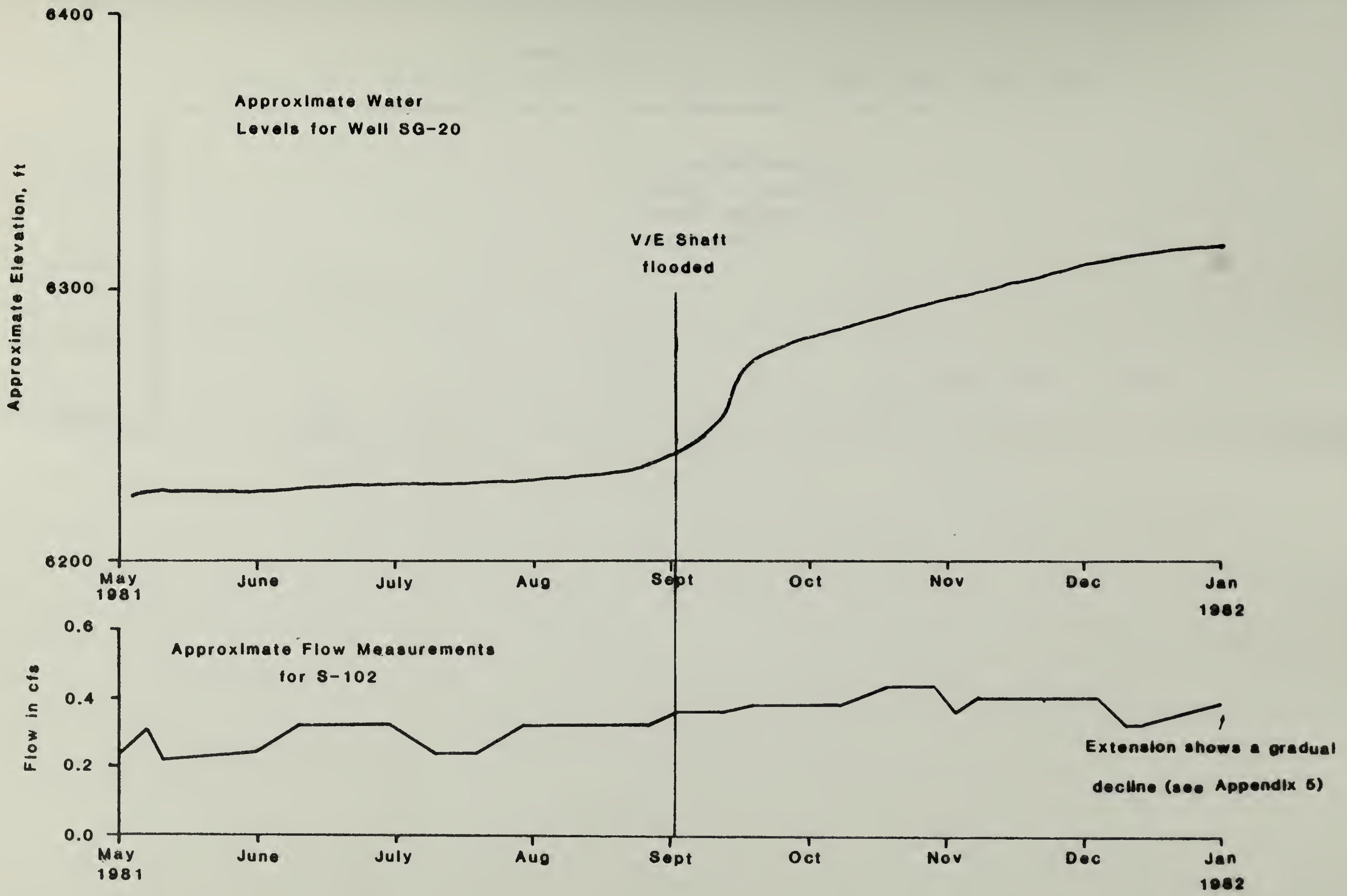

Figure 11. Water Levels in SG-20 and Flow Rates in S-102

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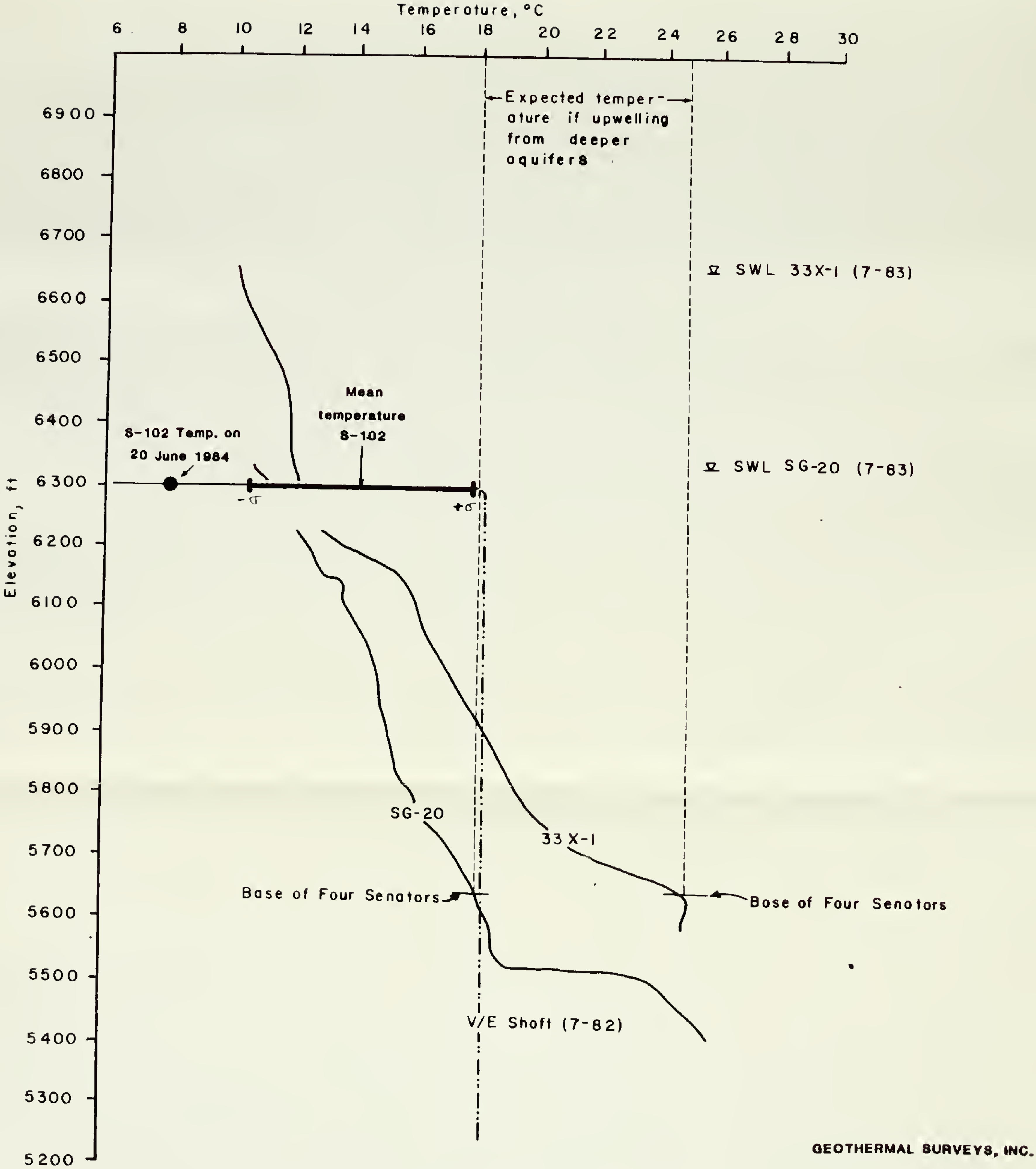

Figure 12. Temperature Considerations
S-102

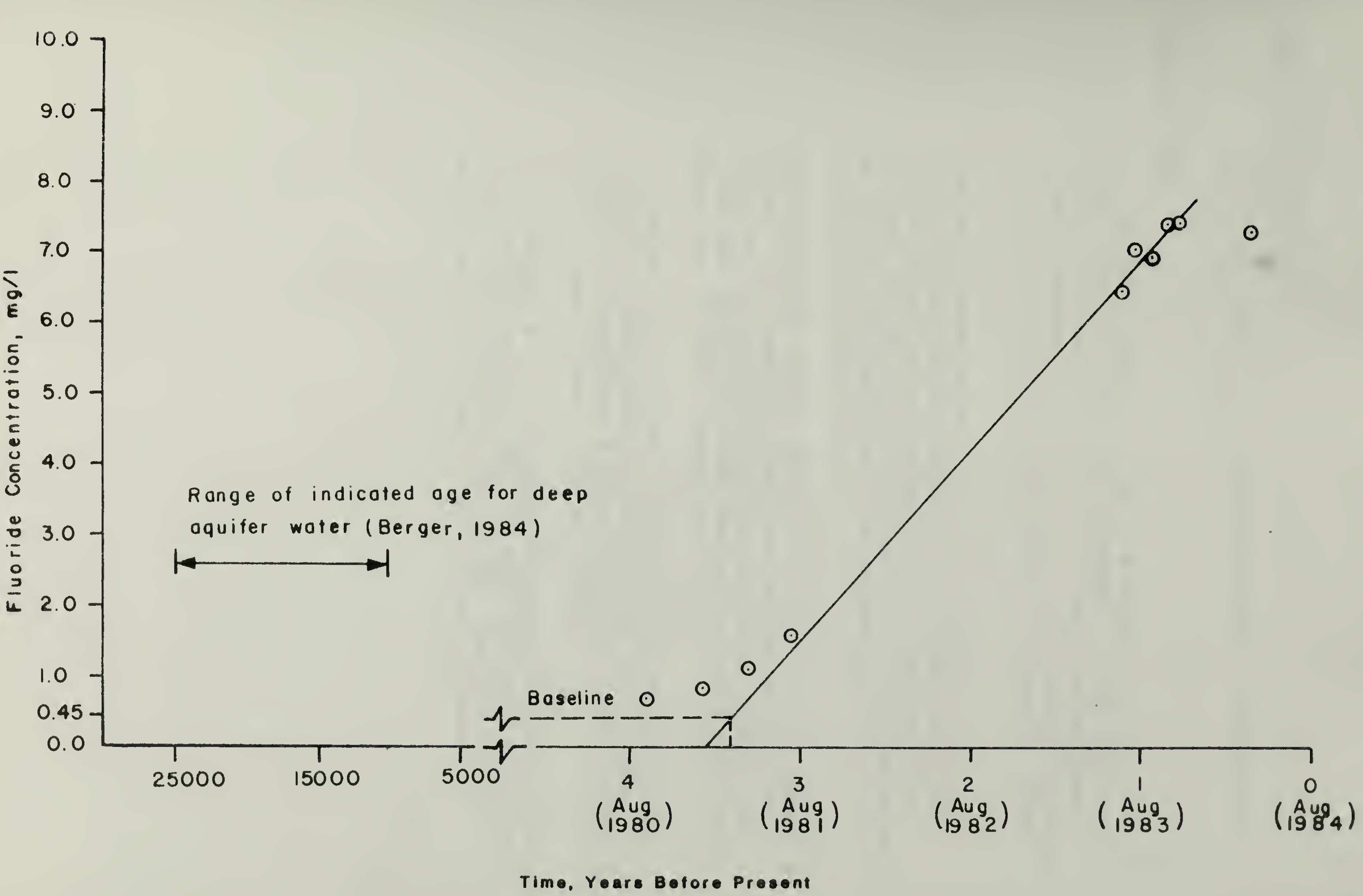

Figure 13. Changes in S-102 Fluoride Concentrations Over Time

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Supporting Evidence

- Fluoride concentrations have recently been as high as 7.5 mg/l in S-102.

Deficiencies

- During the pumping of the V/E Shaft, no decline in flow rates of S-102 was observed. A decline would be expected as a result of a hydraulic gradient direct reversal (from south to north before pumping, to north to south during pumping) (Figures 10 and 11).

- The mean temperature of S-102 is approximately 14°C, which is characteristic of Upper and Lower Uinta ground water temperatures. Temperatures between approximately 18°C and 25°C would be expected at S-102, if upwelling from deeper aquifers is occurring (Figure 12).

- The fluoride levels within S-102 have only recently risen. If upwelling has been occurring for the last several thousand years, we would expect the fluoride levels to have reached an equilibrium and show very little change over time.

- Ten other springs, S-1 through S-11, which are in a similar geohydrologic setting to S-102, show similar temperature trends as S-102. Their temperature means range between 11°C and 15°C.

- S-1 through S-11 also show maximum fluoride concentrations ranging between 0.4 and 9.9 mg/l through September, 1982. This suggests that S-102 (maximum fluoride approximately 7.5 mg/l) is a local phenomenon.

HYPOTHESIS PRIORITIZATION AND RECOMMENDATIONS

Hypothesis	Priority	Recommendations for Testing
1. NPDES discharge into No Name Gulch	1	. Install a flume in No Name Gulch immediately upstream of Field Station 8 to determine if majority of the decline in flow results from direct infiltration into bedrock. . Discontinue discharge into No Name Gulch and wait for decline in fluoride concentration in S-102.
2. Ponds A/B	2	. Investigate actual volume lost to infiltration. . If volumes reported herein are accurate, discontinue use or seal the bottoms of the ponds. After some time (a few years) the fluoride levels in S-102 should diminish. . Investigate 31X-12 as a representative seepage monitor well.
3. Pond C	3	. Wait, values should diminish if this is the source.
4. V/E Shaft	4	. Determine exact elevation of S-102. . Wait, values should level off and stay constant if this is the source.
5. Deep aquifer upwelling	5	. Unnecessary at this time.

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APPENDIX 1

Field Descriptions and Photographs

APPENDIX 1 (See Figure 1)

Field Descriptions - S-102 Reconnaissance

June, 1984

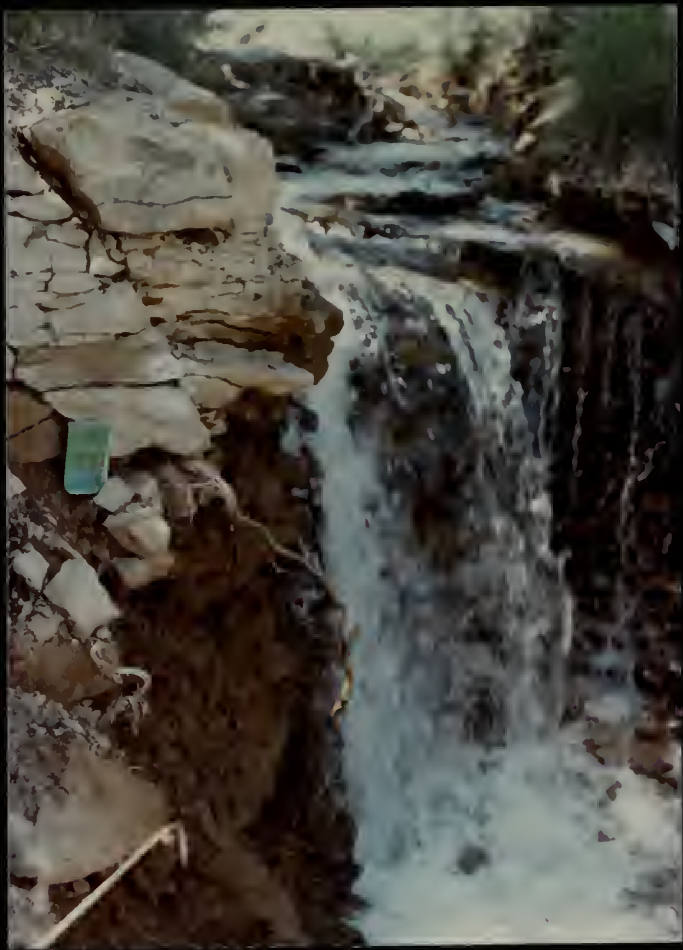
Field Station No.	Photo No.	Description	Joint Attitude	Bedding Attitude
		<u>19 June 1984</u>		
1	1	No Name Gulch: no apparent bedrock exposures within channel	--	--
2	2	Same	--	--
3	3, 4	. East No Name Gulch: 4 ft vertical nickpoint on very fractured, jointed and weathered Upper Uinta bedrock . Water temperature = 21°C	--	--
4	5	East No Name Gulch, left bank: well indurated, very fractured shale overlain by massive sandstone	Shale: N88E 65°N	--
5	6	East No Name Gulch, left bank: crudely bedded sandstone with fissile shale-siltstone laminae	--	N.80E. 10°N
6	7	. East No Name Gulch, left bank: sandstone with minor fissile shale and siltstone laminae. Very weathered and jointed. Joints 1/64" to 1/2" wide. Flow directly over bedrock . Water Temperature = 24°C	N32E N77W 44.5°N	-- --

7	8	No Name Gulch, right bank: sandstone/siltstone with fissile shale laminae. Flow directly over fractured, jointed bedrock.	N36E 86°SE N38E 54°NW	
8	9	No Name Gulch, left bank: crudely bedded sandstone with fissile siltstone laminae. Flow directly over jointed bedrock.	N73W 46°SE N84W 84°N	
9	10a 10b	No Name Gulch, approximately 200 ft upstream from USGS wier. Noticeable decline in flow rate between FS 8 and this station. Some loss may be due to evaporation	--	--
		<u>20 June 1984</u>		
10	11	South bluff of Piceance Creek valley, approximately 1500 ft W-NW of FS 9: massive to jointed sandstone interbedded with calcareous, fissile shales and siltstones. Joints are 1/64" to 1/4" wide and occur every 0.3 to 1 ft (top of Black Sulphur Creek tongue?)	N84W 70°S	N79W 5°S
11	--	South bluff of Piceance Creek valley, 200 ft W-NW of FS 10: lithology same as FS 10	N83E 62.5°S	
12	--	South bluff of Piceance Creek valley: bedded sandstone with fissile shale-siltstone laminae. Joint widths don't exceed 1/64". Joints occur every 0.5 to 1 ft.	N70E 36°S N54W 31.5°N	N83W 9°S

13	12	South bluff of Piceance Creek valley: barren marlstone and shale, very fissile and jointed.	N2W 84°W	N73W 12°S
14	13, 14	Immediately north of V/E Shaft: fractured and jointed sandstone with interbedded shales and siltstone. Joints approximately every 1 ft. Widths range from 1/64" to 1/8".	N74W 72°S N81W 69°S N24E 70°NW	
15	15	West No Name Gulch; W-NW of V/E Shaft: flow 10-20 gpm (0.02-0.04 cfs). Minor alluvium. Jointed sandstone. Water temperature = 15.5°C; Conductivity 600 mhos	N60E 69°NW N85W 81.5°N	
16	--	200 yds south of V/E Shaft along east access road: road cut. Jointed sandstone underlain by fissile, brittle shale and siltstone. Moist at contact between sandstone and shale/siltstone.	--	--
17	--	East of Ponds A/B, 150 ft west of East No Name Gulch: spring issuing from talus and weathered bedrock(?) Conductivity = 1875 mhos Temperature = 20.5°C	--	--
18	16	NPDES discharge into East No Name Gulch	--	--
19	17	Roadcut west side of Ponds A/B	--	--

1

2



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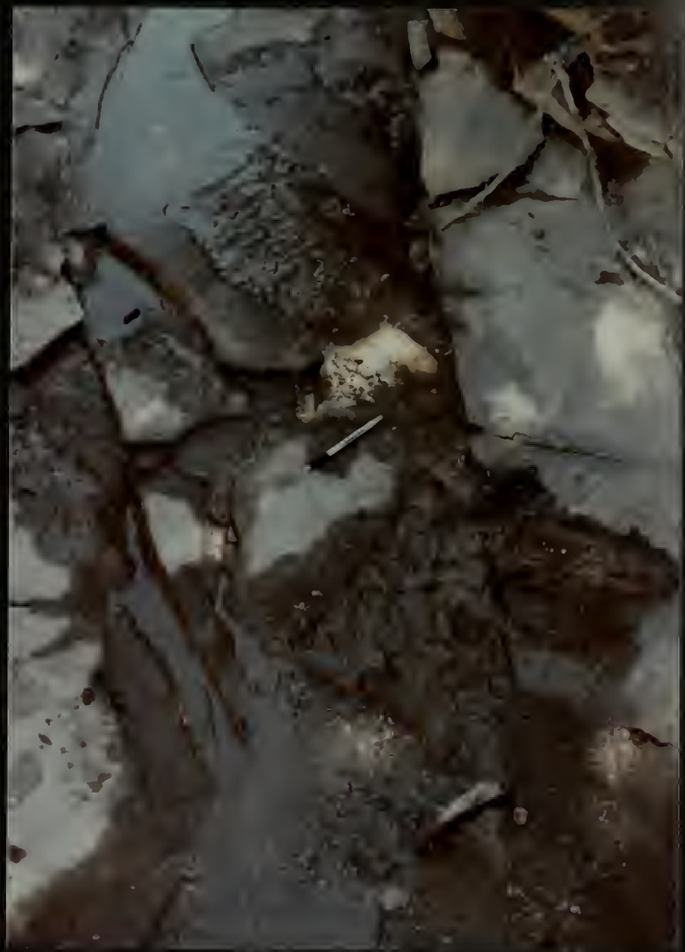


b

10a

10b

11

12

13

14

15

16

17

APPENDIX 2

Estimated Hydraulic Conductivity Calculations

for No Name Gulch

APPENDIX 2

Estimated Hydraulic Conductivity Calculations for No Name Gulch

Assumptions:

1. Darcy's Law is applicable
2. The porosity of the Upper Unita is between 1 and 10 percent
3. January, 1981 is first indication of impact of infiltration from No Name Gulch on S-102

Using

$$\bar{v} = \frac{Ki}{n}$$

becomes

$$K = \frac{\bar{v}\, n}{i}$$

where

$$\bar{v} = \text{velocity} = \text{Scenario 1} \quad \frac{\text{distance from discharge point in No Name Gulch to S-102, ft}}{\text{time between initial discharge into NNG and initial rise in fluoride levels in S-102, days}}$$

$$= \text{Scenario 2} \quad \frac{\text{distance from USGS flume on NNG to S-102, ft}}{\text{time between initial discharge into NNG and initial rise in fluoride levels in S 102, days}}$$

$$\bar{v}_{\text{Scenario 1}} = \frac{9110 \text{ ft}}{480 \text{ days}} = 19.0 \text{ ft/day}$$

$$\bar{v}_{\text{Scenario 2}} = \frac{1500 \text{ ft}}{480 \text{ days}} = 3.1 \text{ ft/day}$$

$$i = \text{hydraulic gradient} = \quad \text{Scenario 1} \quad \frac{\Delta\ \text{elevation between discharge point in NNG and S-102, ft}}{\text{distance from discharge point in NNG to S-102, ft}}$$

$$\text{Scenario 2} \quad \frac{\Delta\ \text{elevation between USGS flume on NNG and S-102, ft}}{\text{distance from USGS flume on NNG to S-102, ft}}$$

$$i_{\text{Scenario 1}} = \frac{385\ \text{ft}}{9110\ \text{ft}} = 0.04$$

$$i_{\text{Scenario 2}} = \frac{20\ \text{ft}}{1500\ \text{ft}} = 0.01$$

\- - - - - - - - - - - -

Scenario 1

Case 1: n = 1 percent

$$K = \frac{(19.0\ \text{ft/day})(0.01)}{(0.04)}$$

$$K = 4.75\ \text{ft/day}$$

Case 2: n = 5 percent

$$K = \frac{(19.0\ \text{ft/day})(0.05)}{(0.04)}$$

$$K = 23.75\ \text{ft/day}$$

Case 3: n = 10 percent

$$K = \frac{(19.0\ \text{ft/day})(0.10)}{(0.04)}$$

$$K = 47.5\ \text{ft/day}$$

Scenario 2

Case 1: $n = 1$ percent

$$K = \frac{(3.1 \text{ ft/day})(0.01)}{(0.01)}$$

$$K = 3.1 \text{ ft/day}$$

Case 2: $n = 5$ percent

$$K = \frac{(3.1 \text{ ft/day})(0.05)}{(0.01)}$$

$$K = 15.5 \text{ ft/day}$$

Case 3: $n = 10$ percent

$$K = \frac{(3.1 \text{ ft/day})(0.10)}{(0.01)}$$

$$K = 31 \text{ ft/day}$$

APPENDIX 3

Estimated Hydraulic Conductivity Calculations for Ponds A/B

APPENDIX 3

Estimated Hydraulic Conductivity Calculations for Ponds A/B

Assumptions:

1. Darcy's law is applicable

2. The porosity of the Upper Uinta is between 1 and 10 percent

3. January, 1981 is first indication of impact of Pond leakage on S-102

Using

$$\bar{V} = \frac{ki}{n}$$

becomes

$$K = \frac{\bar{V}\ n}{i}$$

where

$$\bar{V} = \text{velocity} = \frac{\text{distance from Ponds A/B to S-102, ft}}{\text{time between intial use of Ponds and initial rise in fluoride levels in S-102, days}}$$

$$= \frac{9300 \text{ ft}}{660 \text{ days}}$$

$$= 14.1 \text{ ft/day}$$

$$i = \text{hydraulic gradient} = \frac{\Delta \text{ elevation between Ponds A/B and S-102, ft}}{\text{distance from Ponds A/B to S 102, ft}}$$

$$= \frac{470 \text{ ft}}{9300 \text{ ft}}$$

$= 0.05$

n = porosity, percent

K = hydraulic conductivity, ft/day

\- - - - - - - - - - - -

Case 1: $n = 1$ percent

$$K = \frac{(14.1 \text{ ft/day})(0.01)}{(0.05)}$$

$$= 2.82 \text{ ft/day}$$

Case 2: $n = 5$ percent

$$K = \frac{(14.1 \text{ ft/day})(0.05)}{(0.05)}$$

$$K = 14.1 \text{ ft/day}$$

Case 3: $n = 10$ percent

$$K = \frac{(14.1 \text{ ft/day})(0.10)}{(0.05)}$$

$$= 28.2 \text{ ft/day}$$

APPENDIX 4

Data on Bedrock Seepage Monitor Well 41X-1 (A-5B)

41X-1 (A-5B)

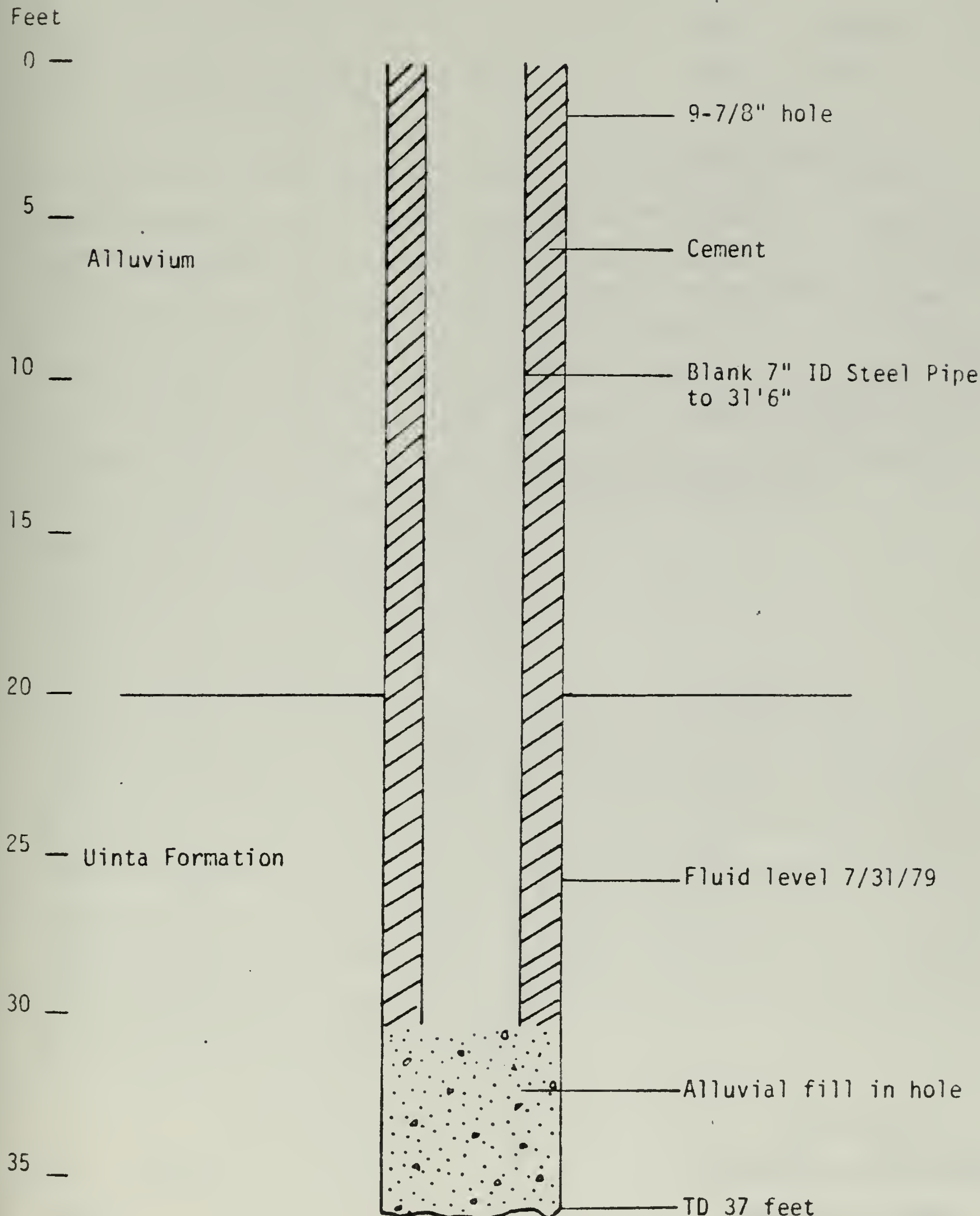
BEDROCK SEEPAGE MONITORING WELL

Location:	Latitude 39° 49' 34" Longitude 108° 13' 19" R97W T2S, Section 36, SW 1/4 of SE 1/4 of SE 1/4 West No Name in East No Name Gulch
Elevation:	Approximately 6460'
Spud Date:	July 26, 1979
Completion Date:	July 27, 1979
Operator:	Occidental Oil Shale, Inc.
Driller:	OOSI Drilling Department
Drilling Method:	Air Rotary
Logs:	None
Specifications:	Diameter of hole: 9-7/8" to T.D. Total depth of hole: 37' Casing: Blank 7" I.D. steep pipe to 31'6" Cement: 0 - 31'6"
Remarks:	(1) First water detected at 37' (2) Fluid level recovered to 25'6" below ground level (3) Two water quality samples obtained 7/31/79 (4) Sloughing in hole filled bedrock portion with alluvium

41X-1

BEDROCK SEEPAGE MONITORING WELL

Completion



OXY INTER-OFFICE MEMORANDUM

ASB

TO: H. S. Skogen
cc: R. R. Bloom
C. B. Bray
G. C. Brun D. F. Rogers

FROM: V. L. Anthony

PROJECT: Oil Shale

SUBJECT: C-b Water Analysis

DATE: November 21, 1979

Sample: B-1237-79 41X-1 10/12/79
BWX41-1-9285-1-00

Lab No. Cb-231

CATIONS		MISCELLANEOUS	
Aluminum, mg/l	<0.1	BOD (5 Days), mg/l	--
Ammonia as N, mg/l	0.3	COD, mg/l	No Sample
Arsenic, mg/l	<0.02	Hardness, mg/l as $CaCO_3$	--
Barium, mg/l	<0.5	Oil & Grease, mg/l	9
Boron, mg/l	0.1	Phenol, mg/l	0.03
Cadmium, mg/l	<0.02	Total Alkalinity, mg/l as $CaCO_3$	250
Calcium, mg/l	82	Total Dissolved Solids, mg/l	840
Chromium, mg/l	<0.02	Kjeldahl Nitrogen, mg/l	1.5
Copper, mg/l	<0.02		
Iron, mg/l	0.03		
Lead, mg/l	<0.02		
Lithium, mg/l	0.02		
Magnesium, mg/l	47	ANIONS	
Manganese, mg/l	0.1	Bicarbonate, mg/l as $CaCO_3$	230
Molybdenum, mg/l	<0.02	Bromide, mg/l	No Sample
Nickel, mg/l	<0.02	Carbonate, mg/l as $CaCO_3$	30
Potassium, mg/l	1.1	Chloride, mg/l	--
Silver, mg/l	<0.02	Fluoride, mg/l	0.4
Sodium, mg/l	110	Nitrate, mg/l	19
Strontium, mg/l	4.2	Sulfate, mg/l	360
Zinc, mg/l	<0.02		

rev: 9-24-79

VLA:jp

OXY INTER-OFFICE MEMORANDUM

TO H. S. Skogen

SUBJECT: CB Water Analysis Report

FROM C. M. Jensen

PROJECT OOSI

SAMPLE NO: B-1514-80

DATE 9/8/80

LOCATION: A-5b

DATE RECEIVED: 8/25/80

CODE: BWA56-1-0235-1-27

LAB NO.:

METALS		NON METALS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	420
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	420
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	<1
Boron, mg/l	0.3	Bromide, mg/l	--
Cadmium, mg/l	<0.01	Chloride, mg/l	20
Calcium, mg/l	69	Fluoride, mg/l	2.0
Chromium, mg/l	<0.02	Hardness(Ca+Mg) mg/l as $CaCO_3$	340
Cobalt, mg/l	<0.02	Nitrogen:	
Copper, mg/l	<0.02	Ammonia, mg/l as N	6.0
Iron, mg/l	0.02	Kjeldahl, mg/l as N	6.9
Lead, mg/l	<0.02	Nitrate, mg/l	6.7
Lithium, mg/l	<0.05	BOD(5-day), mg/l	--
Magnesium, mg/l	40	COD, mg/l	20
Manganese, mg/l	0.5	Oil & Grease, mg/l	2
Mercury, mg/l	<0.0002	Phenols, mg/l	<0.001
Molybdenum, mg/l	0.01	Silica, mg/l	--
Nickel, mg/l	<0.02	Tot.Dissolved Solids, mg/l	870
Potassium, mg/l	1.1	Tot.Suspended Solids, mg/l	--
Selenium, mg/l	<0.01	Sulfate, mg/l	250
Silver, mg/l	<0.01	Turbidity, NTU	--
Sodium, mg/l	190	DOC, mg/l	--
Strontium, mg/l	3.3		
Vanadium, mg/l	--		
Zinc, mg/l	<0.02	BACTERIA	
		Tot.Coliform, colonies/100ml	--
		Fecal Coliform, colonies/100ml	--

rev: 2-11-80

CMJ:jp

t: Total

s: Soluble

cc: E. Baker, J. Feinman
R. P. Oliver, S. L. Stringer

OCCIDENTAL OIL SHALE, INC.

OXY INTER-OFFICE MEMORANDUM

LABORATORY

- TO: H. S. Skogen
SUBJECT C.B. Water Analysis Report
SAMPLE NO.: B-1789-81
LOCATION: A-5B
CODE: BWA56-1-1190-1-27

FROM: C. M. Jersen
PROJECT: - OOSI
REPORT DATE: 7/30/81
DATE RECEIVED: 7/10/81

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	720
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	650
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	68
Boron, mg/l	0.6	Bromide, mg/l	--
Cadmium, mg/l	<0.01	Chloride, mg/l	11
Calcium, mg/l	41	Fluoride, mg/l	2.4
Chromium, mg/l	<0.02	Hardness (Ca+Mg), mg/l as $CaCO_3$	250
Copper, mg/l	0.02	Nitrogen:	
Iron, mg/l	<0.02	Ammonia, mg/l as N	0.3
Lead, mg/l	<0.02	Kjeldahl, mg/l as N	0.4
Lithium, mg/l	<0.05	Nitrate, mg/l	2.9
Magnesium, mg/l	37	Nitrite, mg/l	--
Manganese, mg/l	0.1	Nitrate + Nitrite, mg/l as N	--
Mercury, mg/l	<0.0002	BOD (5-day), mg/l	--
Molybdenum, mg/l	0.01	COD, mg/l	<50
Nickel, mg/l	<0.02	Oil and Grease, mg/l	<10
Potassium, mg/l	6.7	Phenols, mg/l	<0.001
Selenium, mg/l	<0.01	Silica, mg/l	--
Silver, mg/l	<0.01	Tot.Dissolved Solids, mg/l	1000
Sodium, mg/l	310	Tot.Suspended Solids, mg/l	--
Strontium, mg/l	1.3	Sulfur:	
Vanadium, mg/l	--	Sulfate, mg/l	160
Zinc, mg/l	<0.02	Sulfide, mg/l	--
Gallium, mg/l	--	Dissolved Organic Carbon, mg/l	--
Germanium, mg/l	--	Total Coliform, colony/100 ml	--
Titanium, mg/l	--	Fecal Coliform, colony/100 ml	--
Zirconium, mg/l	--	SCN, mg/l	<0.1

CMJ:cmh

t: Total <: Less than

cc: E. Baker, P. Oliver, S. Stringer, G. Ullinskey, C.B. Central Records

rev: 4/7/81

OXY INTER-OFFICE MEMORANDUM

LABORATORY

C B PROJECT ENVIRONMENTAL SERVICES

NOV 1 3 1981

REC'D

TO: H. S. Skogen
SUBJECT C.B. Water Analysis Report
SAMPLE NO.: B-1928
LOCATION: A-5B
CODE: 6WA56-1-1293-1-29

FROM: D. G. Lowe
PROJECT: OOSI
REPORT DATE: 11-11-81
DATE RECEIVED: 10-21-81

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	780
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	730
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	52
Boron, mg/l	0.6	Bromide, mg/l	0.8
Cadmium, mg/l	<0.01	Chloride, mg/l	9.5
Calcium, mg/l	40	Fluoride, mg/l	13
Chromium, mg/l	<0.02	Hardness (Ca+Mg), mg/l as $CaCO_3$	190
Copper, mg/l	0.02	Nitrogen:	
Iron, mg/l	0.03	Ammonia, mg/l as N	0.05
Lead, mg/l	<0.02	Kjeldahl, mg/l as N	<0.1
Lithium, mg/l	<0.05	Nitrate, mg/l	7.1
Magnesium, mg/l	22	Nitrite, mg/l	
Manganese, mg/l	0.02	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l	<0.0002	BOD (5-day), mg/l	<150
Molybdenum, mg/l	<0.01	COD, mg/l	<50
Nickel, mg/l	0.03	Oil and Grease, mg/l	<10
Potassium, mg/l	1.1	Phenols, mg/l	<0.001
Selenium, mg/l	<0.01	Silica, mg/l	
Silver, mg/l	<0.01	Tot.Dissolved Solids, mg/l	1100
Sodium, mg/l	370	Tot.Suspended Solids, mg/l	
Strontium, mg/l	1.5	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	200
Zinc, mg/l	<0.02	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	<0.1
Germanium, mg/l		Dissolved Organic Carbon, mg/l	10
Titanium, mg/l		Total Coliform, colony/100 ml	5
Zirconium, mg/l		Fecal Coliform, colony/100 ml	<1

DGL:cmn

t: Total <: Less than

cc: E. Baker, P. Oliver, S. Stringer, G. Ullinskey, C.P. Central Records

rev: 11-6-81

OCCIDENTAL OIL SHALE, INC.

APPENDIX 5

Spring Data

Includes statistical data, flow rates and temperatures

LIST OF SPRING FLOW TIME SERIES PLOTS

Computer Code	Location
WS01	CB S-1
WS02	CB S-2
WS03	CB S-3
WS04	CB S-4
WS06	CB S-6
WS07	CB S-7
WS08	CB S-8
WS09	CB S-9
WS10	CB S-10
WS11	CB S-10A (Seep)
WS12	CB S-102
WS13	CB S-102A
WS21	CER-1
WS22	B-3
WS23	H-3
WS24	F-3
WS25	Figure 4-A
WS26	W-4
WS27	W-9
WS28	CER-7
WS29	S-9
WS30	P3 & P3A
WS31	CER-6
WS32	W-2 (CB S-9)
WS33	S-2
WS34	W-3 (CB S-10)
WS35	Figure 4
WS36	CB S-101
WS37	Oldland Spring
WS66	CB S-6A

LOC=#501

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	13	436.92	49.06	400.00	580.00
AL	AL	13	0.13	0.09	0.08	0.40
ARS	ARS	13	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	7	4.71	8.98	1.00	25.00
BA	BA	13	0.50	0.00	0.50	0.50
HCO3	HCO3	13	405.38	61.32	340.00	580.00
BOD	BOD	13	19.14	41.18	0.10	150.00
B	B	13	0.11	0.05	0.04	0.20
BR	BR	6	0.37	0.24	0.20	0.85
TCOLIF	TCOLIF	6	33.83	58.08	1.00	150.00
CD	CD	13	0.02	0.01	0.01	0.02
CA	CA	13	83.69	23.30	40.00	130.00
CO3	CO3	13	31.00	30.78	1.00	90.00
CL	CL	13	13.65	11.31	6.40	40.00
CR	CR	13	0.02	0.00	0.02	0.02
COD	COD	13	11.94	15.63	1.00	50.00
CU	CU	13	0.02	0.00	0.02	0.02
DO	DO	8	7.17	1.97	4.40	11.00
DOC	DOC	5	9.80	13.87	1.70	34.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	13	0.28	0.07	0.20	0.40
HARD	HARD	13	528.46	74.48	380.00	680.00
FE	FE	13	0.15	0.24	0.02	0.70
KJN	KJN	12	0.53	0.57	0.10	2.00
PB	PB	13	0.03	0.02	0.02	0.08
LI	LI	13	0.04	0.02	0.02	0.05
MG	MG	13	75.46	10.44	60.00	100.00
MN	MN	13	0.03	0.05	0.02	0.20
HG	HG	12	0.01	0.01	0.00	0.02
MOLY	MOLY	13	0.02	0.01	0.01	0.05
NI	NI	13	0.02	0.00	0.02	0.03
NO3	NO3	14	349.77	1280.93	0.10	4800.00
OLGR	OLGR	13	8.00	7.11	1.00	20.00
S2O3	S2O3	2	8.00	5.66	4.00	12.00
PH	PH	8			7.50	9.20
K	K	13	1.92	0.48	1.40	3.20
RA	RA	8	3.73	2.83	1.20	9.10
BIR	BIR	5	16.80	17.51	2.00	46.00
RN	RN	2	0.55	0.64	0.10	1.00
SE	SE	11	0.02	0.01	0.01	0.03
AG	AG	13	0.02	0.02	0.01	0.10
NA	NA	13	127.92	9.37	110.00	140.00
TDS	TDS	11	798.20	397.32	0.10	1100.00
SOLS	SOLS	4	973.75	22.87	945.00	1000.00
SPC	SPC	9	1208.11	262.91	760.00	1480.00
SR	SR	12	5.15	1.15	3.00	7.00
SO4	SO4	13	348.46	50.47	270.00	440.00
TEMP	TEMP	7	14.90	5.65	6.50	21.00
ZN	ZN	13	0.02	0.00	0.01	0.03
TOC	TOC	3	20.67	14.57	9.00	37.00
PHEN	PHEN	12	0.06	0.20	0.00	0.69
CYAN	CYAN	0	.	.	.	.
NH3	NH3	12	0.12	0.13	0.04	0.40

LOC=4502

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	14	400.71	20.56	340.00	430.00
AL	AL	14	0.16	0.12	0.10	0.50
ARS	ARS	14	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	6	45.88	120.49	1.00	344.00
BA	BA	14	0.52	0.08	0.50	0.80
HCO3	HCO3	14	349.29	34.96	260.00	420.00
BOD	BOD	14	28.96	52.63	0.40	150.00
B	B	14	0.18	0.24	0.04	1.00
BR	BR	7	0.54	0.30	0.10	1.00
TCOLIF	TCOLIF	6	1403.17	3235.50	1.00	8000.00
CD	CD	14	0.01	0.01	0.01	0.02
CA	CA	14	85.00	17.70	53.00	110.00
CO3	CO3	14	51.64	27.79	10.00	110.00
CL	CL	14	10.80	12.45	2.00	51.00
CR	CR	14	0.02	0.00	0.02	0.02
COD	COD	14	12.72	18.27	1.00	50.00
CU	CU	14	0.03	0.02	0.02	0.10
DO	DO	9	7.22	1.86	3.40	10.30
DOC	DOC	3	11.33	11.68	1.00	24.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	14	0.27	0.07	0.20	0.40
HARD	HARD	14	494.29	70.35	370.00	600.00
FE	FE	14	0.16	0.23	0.02	0.50
KJN	KJN	12	0.67	0.91	0.10	3.00
PB	PB	14	0.02	0.01	0.02	0.05
LI	LI	14	0.04	0.01	0.02	0.05
MG	MG	14	70.71	9.29	57.00	89.00
MN	MN	14	0.03	0.02	0.02	0.10
HG	HG	14	0.01	0.01	0.00	0.02
MOLY	MOLY	14	0.04	0.08	0.01	0.30
NI	NI	14	0.02	0.00	0.02	0.03
NO3	NO3	15	323.48	1238.40	0.10	4800.00
OLGR	OLGR	14	6.93	8.10	1.00	31.00
S2O3	S2O3	2	6.00	2.83	4.00	8.00
PH	PH	9			7.60	8.80
K	K	14	1.44	0.97	0.70	4.20
RA	RA	0	3.01	1.83	1.00	6.00
BTH	BTH	7	5.14	4.45	1.00	14.00
RN	RN	1	0.30	.	0.30	0.30
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	15	0.03	0.05	0.01	0.20
NA	NA	14	112.86	9.94	100.00	130.00
TDS	TDS	12	697.52	327.35	0.10	880.00
SOLS	SOLS	4	887.50	165.20	650.00	1000.00
SPC	SPC	9	1168.89	95.58	1020.00	1300.00
SH	SH	13	4.93	1.29	2.70	7.00
SO4	SO4	14	298.57	48.33	210.00	360.00
TEMP	TEMP	8	13.67	4.23	6.30	20.00
ZN	ZN	14	0.03	0.03	0.01	0.10
TOC	TOC	4	10.50	12.07	1.00	27.00
PHEN	PHEN	14	0.01	0.01	0.00	0.04
CYAN	CYAN	0	.	.	.	.
NH3	NH3	14	0.19	0.25	0.04	0.75

LOC=WS03

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	16	431.44	28.35	400.00	513.00
AL	AL	16	0.14	0.11	0.03	0.50
ARS	ARS	16	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	10	30.10	83.93	1.00	268.00
BA	BA	16	0.50	0.00	0.50	0.50
HCO3	HCO3	16	410.19	40.34	300.00	513.00
BOD	BOD	16	25.02	38.54	0.60	150.00
B	B	16	0.09	0.05	0.04	0.20
BR	BR	9	0.56	0.21	0.30	1.00
TCOLIF	TCOLIF	6	69.83	113.90	1.00	292.00
CD	CD	16	0.02	0.01	0.01	0.02
CA	CA	16	82.38	21.48	43.00	120.00
CO3	CO3	16	21.81	27.61	1.00	100.00
CL	CL	16	13.32	12.34	6.00	47.00
CR	CR	16	0.02	0.00	0.02	0.04
COD	COD	16	8.81	14.13	1.00	50.00
CU	CU	16	0.03	0.03	0.02	0.10
DO	DO	10	7.41	1.84	3.10	9.50
DOC	DOC	5	13.80	14.10	1.00	38.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	16	0.28	0.08	0.20	0.40
HARD	HARD	16	543.75	90.62	370.00	700.00
FE	FE	16	0.20	0.24	0.02	0.50
KJN	KJN	13	0.92	1.32	0.07	4.10
PB	PB	16	0.04	0.05	0.02	0.20
LI	LI	16	0.03	0.02	0.01	0.05
MG	MG	16	77.25	13.66	55.00	98.00
MN	MN	16	0.03	0.03	0.02	0.10
HG	HG	15	0.01	0.01	0.00	0.02
MOLY	MOLY	16	0.03	0.05	0.01	0.20
NI	NI	16	0.03	0.04	0.02	0.20
NO3	NO3	17	286.80	1163.02	0.10	4800.00
ODOR	ODOR	16	7.69	6.24	1.00	26.00
S2O3	S2O3	2	8.50	6.36	4.00	13.00
PH.	PH	10			7.30	8.40
K	K	16	2.01	0.65	0.60	3.20
RA	RA	9	3.06	2.20	0.20	6.10
BIM	BIM	4	14.50	5.92	9.00	21.00
RN	RN	1	0.10	.	0.10	0.10
SE	SE	11	0.01	0.01	0.01	0.02
AG	AG	16	0.03	0.03	0.01	0.10
NA	NA	16	127.00	12.65	110.00	150.00
TDS	TDS	14	816.46	477.97	0.10	1000.00
SOLS	SOLS	7	1514.29	1450.29	890.00	4800.00
SPC	SPC	9	1304.44	119.70	1050.00	1440.00
SR	SR	15	4.91	1.04	3.00	7.10
SO4	SO4	16	403.63	145.90	218.00	690.00
TEMP	TEMP	9	14.44	4.12	7.50	19.00
ZN	ZN	16	0.03	0.03	0.01	0.10
TOC	TOC	6	16.17	9.89	4.00	28.00
PHEN	PHEN	15	0.00	0.01	0.00	0.02
CYAN	CYAN	0	.	.	.	.
NH3	NH3	15	0.14	0.16	0.02	0.60

LOC=#504

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	14	397.14	27.01	320.00	420.00
AL	AL	14	0.11	0.06	0.01	0.30
ARS	ARS	14	0.03	0.05	0.02	0.20
FCOLIF	FCOLIF	8	33.00	80.89	1.00	248.00
BA	BA	14	0.50	0.04	0.40	0.60
HCO3	HCO3	14	359.29	28.14	300.00	400.00
BOD	BOD	14	35.32	52.59	0.50	150.00
B	B	14	0.18	0.14	0.09	0.59
BR	BR	7	0.52	0.22	0.30	0.84
TCOLIF	TCOLIF	6	2555.50	6097.62	1.00	15000.00
CD	CD	14	0.01	0.01	0.01	0.02
CA	CA	14	86.50	21.50	47.00	120.00
CO3	CO3	14	37.71	20.50	12.00	90.00
CL	CL	14	11.41	11.18	3.60	43.00
CR	CR	14	0.02	0.00	0.02	0.01
COD	COD	14	11.86	17.06	1.00	50.00
CU	CU	14	0.03	0.02	0.02	0.10
DO	DO	9	7.14	2.27	3.00	11.40
DOC	DOC	3	7.67	6.51	1.00	14.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	14	0.26	0.08	0.19	0.40
HARD	HARD	14	499.29	99.80	330.00	650.00
FE	FE	14	0.16	0.23	0.02	0.50
KJN	KJN	12	0.59	0.71	0.07	2.00
PB	PB	14	0.02	0.01	0.02	0.05
LI	LI	14	0.04	0.01	0.02	0.05
MG	MG	14	70.29	13.46	50.00	98.00
MN	MN	14	0.03	0.03	0.02	0.10
HG	HG	13	0.01	0.01	0.00	0.02
MOLY	MOLY	14	0.02	0.02	0.01	0.10
NI	NI	14	0.02	0.00	0.02	0.03
NO3	NO3	15	324.26	1238.19	0.10	4800.00
OLGR	OLGR	14	5.79	7.30	1.00	28.00
S2O3	S2O3	3	6.33	6.81	1.00	14.00
PH	PH	9			7.50	8.60
K	K	14	1.59	1.06	0.80	3.80
RA	RA	4	1.95	1.22	0.60	3.00
BTR	BTR	5	6.20	2.49	2.00	8.00
RN	RN	1	0.20	.	0.20	0.20
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	16	0.02	0.02	0.01	0.10
NA	NA	14	113.50	11.60	90.00	130.00
TDS	TDS	12	744.18	361.46	0.10	1200.00
SOLS	SOLS	4	967.50	155.21	880.00	1200.00
SPC	SPC	9	1183.33	118.64	1010.00	1390.00
SR	SR	13	4.80	1.23	2.70	7.00
SO4	SO4	14	315.00	80.84	150.00	470.00
TEMP	TEMP	8	13.52	3.81	6.00	18.50
ZN	ZN	14	0.03	0.02	0.01	0.10
TOC	TOC	4	10.00	6.38	1.00	16.00
PHEN	PHEN	14	0.01	0.01	0.00	0.02
CYAN	CYAN	0	.	.	.	.
NH3	NH3	14	0.16	0.19	0.04	0.60

LOC=#506

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	16	498.38	178.78	1.00	930.00
AL	AL	15	0.12	0.06	0.10	0.30
ARS	ARS	15	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	8	17.38	39.68	1.00	115.00
BA	BA	15	0.60	0.39	0.50	2.00
HCO3	HCO3	15	506.87	128.35	380.00	900.00
BOD	BOD	15	33.66	50.76	0.30	150.00
B	B	15	0.11	0.05	0.04	0.23
BR	BR	7	0.59	0.24	0.10	0.80
TCOLIF	TCOLIF	6	98.17	152.99	1.00	390.00
CD	CD	15	0.02	0.01	0.01	0.02
CA	CA	15	89.33	23.06	39.00	110.00
CO3	CO3	15	24.87	20.22	1.00	60.00
CL	CL	15	16.57	11.91	6.50	57.00
CR	CR	15	0.02	0.00	0.02	0.02
COD	COD	15	12.34	17.43	0.10	50.00
CU	CU	15	0.03	0.02	0.02	0.10
DO	DO	10	6.34	1.65	4.00	9.60
DOC	DOC	4	8.00	6.48	1.00	14.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	15	0.49	0.11	0.23	0.70
HARD	HARD	15	573.33	86.49	400.00	700.00
FE	FE	15	0.18	0.23	0.02	0.50
KJN	KJN	13	0.61	0.89	0.07	3.00
PB	PB	15	0.03	0.02	0.02	0.10
LI	LI	15	0.04	0.02	0.02	0.05
MG	MG	15	85.53	9.84	62.00	94.00
MN	MN	15	0.03	0.02	0.02	0.10
HG	HG	15	0.01	0.01	0.00	0.02
MOLY	MOLY	15	0.04	0.07	0.01	0.30
NI	NI	15	0.02	0.00	0.02	0.02
NO3	NO3	16	303.58	1199.06	0.10	4800.00
OLGR	OLGR	15	8.60	12.41	1.00	40.00
S2O3	S2O3	3	4.67	1.51	1.00	8.00
PH	PH	10			6.90	8.10
K	K	15	2.53	0.89	1.80	4.60
RA	RA	7	3.76	3.84	0.30	12.00
RIM	BIM	5	9.00	3.54	4.00	13.00
RR	RR	1	0.20	.	0.20	0.20
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	17	0.02	0.01	0.01	0.06
NA	NA	15	134.20	12.55	110.00	150.00
TDS	TDS	13	773.87	443.89	0.10	1100.00
SOLS	SOLS	5	1055.20	61.93	976.00	1100.00
SPC	SPC	10	1368.10	113.16	1215.00	1558.00
SR	SR	14	6.06	1.23	3.60	8.40
SO4	SO4	15	355.80	34.19	280.00	420.00
TEMP	TEMP	9	13.32	3.47	8.00	19.00
ZN	ZN	15	0.03	0.02	0.02	0.10
TOC	TOC	4	10.75	7.23	4.00	17.00
PHEN	PHEN	14	0.00	0.00	0.00	0.01
CYAN	CYAN	0	.	.	.	.
NH3	NH3	14	0.06	0.04	0.04	0.20

LOC=W507

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	16	486.25	27.54	440.00	570.00
AL	AL	16	0.10	0.01	0.04	0.10
AMS	AMS	16	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	9	4.89	11.67	1.00	36.00
BA	BA	16	0.59	0.38	0.50	2.00
HCO3	HCO3	16	468.13	46.65	350.00	570.00
BOD	BOD	16	36.54	53.75	0.30	150.00
B	B	16	0.13	0.09	0.04	0.40
BR	BR	8	0.58	0.21	0.30	0.90
TCOLIF	TCOLIF	8	38.00	71.54	1.00	180.00
CD	CD	16	0.03	0.05	0.01	0.20
CA	CA	16	92.19	22.99	42.00	120.00
CO3	CO3	16	18.88	27.78	1.00	90.00
CL	CL	16	15.47	9.93	8.00	48.00
CR	CR	16	0.02	0.00	0.02	0.02
COD	COD	16	11.86	16.07	1.00	50.00
CU	CU	16	0.02	0.02	0.02	0.10
DO	DO	11	6.69	1.90	2.80	9.20
DOC	DOC	7	16.24	21.90	1.00	48.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	16	0.49	0.10	0.40	0.80
HARD	HARD	16	586.25	79.57	410.00	690.00
FE	FE	16	0.17	0.23	0.02	0.50
KJN	KJN	14	0.63	0.92	0.07	3.00
PB	PB	16	0.04	0.05	0.02	0.20
LI	LI	16	0.04	0.02	0.02	0.05
MG	MG	16	83.06	11.05	61.00	100.00
MN	MN	16	0.03	0.02	0.02	0.10
HG	HG	16	0.01	0.01	0.00	0.02
MOLY	MOLY	16	0.02	0.01	0.01	0.07
NI	NI	16	0.02	0.00	0.02	0.02
NO3	NO3	16	535.83	1551.32	0.10	4800.00
OLGR	OLGR	16	6.63	10.69	1.00	45.00
S2O3	S2O3	2	6.50	4.95	3.00	10.00
PH	PH	12			7.00	8.40
K	K	16	2.22	0.91	1.40	5.00
RA	RA	6	5.67	5.32	0.30	12.70
BTR	BTR	4	8.75	2.87	7.00	13.00
RN	RN	1	0.20	.	0.20	0.20
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	17	0.02	0.02	0.01	0.10
NA	NA	16	130.44	7.77	120.00	140.00
TDS	TDS	14	710.03	466.13	0.10	1000.00
SOLS	SOLS	6	1642.50	1597.76	855.00	4900.00
SPC	SPC	11	1316.36	219.38	800.00	1620.00
SR	SR	15	6.41	1.30	3.80	8.40
SO4	SO4	16	389.13	153.00	156.00	910.00
TEMP	TEMP	10	13.06	3.55	8.00	19.00
ZN	ZN	16	0.03	0.02	0.02	0.10
TOC	TOC	4	8.50	5.20	1.00	13.00
PHEN	PHEN	15	0.00	0.01	0.00	0.02
CYAN	CYAN	0	.	.	.	.
NH3	NH3	15	0.45	1.16	0.04	4.50

LOC=#508

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	7	462.86	22.89	430.00	480.00
AL	AL	7	0.11	0.04	0.10	0.20
ARS	ARS	7	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	3	634.00	1096.39	1.00	1900.00
BA	BA	7	0.50	0.00	0.50	0.50
HCO3	HCO3	7	412.86	57.36	310.00	480.00
BOD	BOD	7	29.90	45.97	0.30	130.00
B	B	6	0.09	0.02	0.04	0.10
BR	BR	2	0.55	0.21	0.40	0.70
TCOLIF	TCOLIF	2	1205.00	1548.56	110.00	2300.00
CD	CD	7	0.02	0.01	0.01	0.02
CA	CA	7	85.29	23.32	59.00	120.00
CO3	CO3	7	50.14	60.70	1.00	170.00
CL	CL	7	26.57	25.69	11.00	82.00
CR	CR	7	0.02	0.00	0.02	0.02
COD	COD	7	8.00	16.36	1.00	45.00
CU	CU	7	0.03	0.03	0.02	0.10
DO	DO	3	6.70	0.70	6.20	7.50
DOC	DOC	2	1.00	0.00	1.00	1.00
LAS	LAS	0	.	.	.	.
F	F	7	0.52	0.10	0.40	0.70
HARD	HARD	7	537.14	94.11	400.00	640.00
FE	FE	7	0.10	0.18	0.02	0.50
KJN	KJN	5	0.38	0.31	0.10	0.80
PB	PB	7	0.02	0.00	0.02	0.02
LI	LI	7	0.04	0.01	0.02	0.05
MG	MG	7	74.29	15.83	61.00	100.00
MN	MN	7	0.03	0.03	0.02	0.10
HG	HG	8	0.01	0.01	0.00	0.02
MOLY	MOLY	7	0.03	0.03	0.01	0.08
NI	NI	7	0.03	0.03	0.02	0.10
NO3	NO3	8	604.55	1695.24	0.10	4800.00
OLGR	OLGR	7	2.00	1.15	1.00	4.00
S2O3	S2O3	0	.	.	.	.
PH	PH	3			7.20	7.40
K	K	7	2.26	0.75	1.60	3.70
RA	RA	3	3.33	1.42	1.70	4.30
BIR	BIR	1	4.00	.	4.00	4.00
RR	RR	0	.	.	.	.
SE	SE	5	0.02	0.01	0.01	0.03
AG	AG	9	0.02	0.01	0.01	0.04
NA	NA	7	125.71	9.76	120.00	140.00
TDS	TDS	7	842.87	372.42	0.10	1000.00
SOLS	SOLS	1	4400.00	.	4400.00	4400.00
SPC	SPC	3	1380.00	65.57	1320.00	1450.00
SR	SR	8	6.25	0.78	5.00	7.30
SO4	SO4	7	338.57	67.44	250.00	440.00
TEMP	TEMP	2	13.00	2.83	11.00	15.00
ZN	ZN	7	0.03	0.03	0.02	0.10
TOC	TOC	1	2.00	.	2.00	2.00
PHEN	PHEN	7	0.00	0.00	0.00	0.01
CYAN	CYAN	0	.	.	.	.
NH3	NH3	7	0.14	0.22	0.04	0.64

LOC=509

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	15	484.33	56.66	400.00	665.00
AL	AL	15	0.13	0.08	0.04	0.40
ARS	ARS	15	0.03	0.05	0.02	0.20
FCOLIF	FCOLIF	8	49.25	134.46	1.00	382.00
BA	BA	15	0.51	0.02	0.50	0.59
HCO3	HCO3	15	462.67	67.11	380.00	665.00
BOD	BOD	15	38.89	57.43	0.40	150.00
B	B	14	0.12	0.08	0.04	0.32
BR	BR	7	0.54	0.27	0.10	0.90
TCOLIF	TCOLIF	6	127.67	191.38	1.00	422.00
CD	CD	15	0.02	0.01	0.01	0.02
CA	CA	15	95.73	24.79	42.00	120.00
CO3	CO3	15	22.20	26.08	1.00	65.00
CL	CL	15	16.71	16.51	8.00	70.00
CR	CR	15	0.02	0.00	0.02	0.02
COD	COD	15	9.47	16.94	0.10	50.00
CU	CU	15	0.03	0.02	0.02	0.10
DO	DO	10	6.43	1.72	2.60	9.40
DOC	DOC	3	7.33	8.39	2.00	17.00
LAS	LAS	2	0.04	0.01	0.04	0.05
F	F	15	0.46	0.15	0.30	0.90
HARD	HARD	15	574.00	84.16	430.00	690.00
FE	FE	15	0.15	0.22	0.02	0.50
KJN	KJN	13	0.54	0.90	0.07	3.00
PB	PB	15	0.03	0.02	0.02	0.10
LI	LI	15	0.04	0.02	0.02	0.05
MG	MG	15	80.67	10.52	63.00	100.00
MN	MN	15	0.03	0.02	0.02	0.10
HG	HG	14	0.01	0.01	0.00	0.02
MOLY	MOLY	15	0.02	0.01	0.01	0.05
NI	NI	15	0.02	0.00	0.02	0.02
NO3	NO3	16	302.03	1199.47	0.10	4800.00
ORGN	ORGN	15	4.40	3.62	1.00	10.00
S2O3	S2O3	2	8.00	5.66	4.00	12.00
PH	PH	10			7.20	8.20
K	K	15	1.65	0.96	1.00	4.60
RA	RA	6	3.03	3.15	1.00	9.30
BTH	BTH	7	3.29	2.21	1.00	7.00
RR	RR	1	0.20	.	0.20	0.20
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	17	0.02	0.05	0.01	0.20
NA	NA	15	122.67	12.80	100.00	150.00
TDS	TDS	13	743.10	424.64	0.10	1000.00
SOLS	SOLS	5	968.00	48.68	890.00	1000.00
SPC	SPC	10	1329.00	120.60	1130.00	1550.00
SH	SH	14	6.04	1.34	3.50	8.00
SO4	SO4	15	325.73	59.44	190.00	420.00
TEMP	TEMP	8	11.85	3.55	6.00	16.00
ZN	ZN	15	0.03	0.02	0.02	0.10
TOC	TOC	4	15.50	6.76	9.00	25.00
PHEN	PHEN	14	0.00	0.00	0.00	0.01
CYAN	CYAN	0	.	.	.	.
NH3	NH3	14	0.09	0.09	0.04	0.30

LOC=W510

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	15	463.93	58.77	340.00	636.00
AL	AL	15	0.17	0.23	0.10	1.00
ARS	ARS	15	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	8	56.38	102.58	1.00	276.00
BA	BA	15	0.55	0.21	0.50	1.30
HCO3	HCO3	15	434.33	75.92	310.00	636.00
BOD	BOD	15	38.64	57.90	0.40	150.00
B	B	14	0.13	0.11	0.04	0.48
BR	BR	7	0.64	0.15	0.40	0.91
TCOLIF	TCOLIF	6	425.17	832.06	1.00	2100.00
CD	CD	15	0.02	0.01	0.01	0.02
CA	CA	15	90.93	22.98	49.00	120.00
CO3	CO3	15	29.80	33.33	1.00	96.00
CL	CL	15	13.76	9.40	8.00	47.00
CR	CR	15	0.02	0.00	0.02	0.02
COD	COD	15	11.54	17.21	0.10	50.00
CU	CU	15	0.03	0.02	0.02	0.10
DO	DO	10	6.97	2.56	3.00	11.20
DOC	DOC	3	6.67	9.81	1.00	18.00
LAS	LAS	2	0.05	0.02	0.04	0.07
F	F	15	0.45	0.08	0.36	0.70
HARD	HARD	15	541.33	88.14	360.00	660.00
FE	FE	15	0.15	0.22	0.02	0.50
KJN	KJN	14	0.51	0.63	0.10	2.00
PB	PB	15	0.04	0.05	0.02	0.20
LI	LI	15	0.03	0.02	0.01	0.05
MG	MG	15	72.00	19.54	13.00	100.00
MN	MN	15	0.03	0.02	0.02	0.10
HG	HG	15	0.01	0.01	0.00	0.02
MOLY	MOLY	15	0.02	0.02	0.01	0.10
NI	NI	15	0.02	0.02	0.02	0.08
NO3	NO3	16	301.92	1199.49	0.10	4800.00
OLGM	OLGM	15	6.35	6.45	1.00	20.00
S2O3	S2O3	2	7.50	4.95	4.00	11.00
PH	PH	10			7.50	8.60
K	K	15	1.74	0.83	1.00	3.80
RA	RA	6	2.20	0.88	1.00	3.00
BIR	BIR	6	5.67	2.58	2.00	8.00
RR	RR	1	0.30	.	0.30	0.30
SE	SE	12	0.01	0.01	0.01	0.02
AG	AG	17	0.02	0.05	0.01	0.20
NA	NA	15	114.67	9.90	100.00	140.00
TDS	TDS	13	718.46	410.46	0.10	970.00
SOLS	SOLS	5	910.00	118.95	710.00	1000.00
SPC	SPC	10	1281.00	120.41	1090.00	1470.00
SR	SR	14	5.04	1.54	2.00	7.30
SO4	SO4	15	339.60	55.80	240.00	440.00
TEMP	TEMP	8	11.60	3.73	6.00	18.00
ZN	ZN	14	0.03	0.02	0.02	0.10
TOC	TOC	4	23.75	26.06	5.00	62.00
PHEN	PHEN	14	0.00	0.01	0.00	0.02
CYAN	CYAN	0	.	.	.	.
NH3	NH3	14	0.11	0.12	0.04	0.50

LOC=WS11

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	6	466.67	10.33	450.00	480.00
AL	AL	6	0.10	0.00	0.10	0.10
ARS	ARS	6	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	3	57.33	59.75	1.00	120.00
BA	BA	6	0.50	0.00	0.50	0.50
HCO3	HCO3	6	450.00	20.98	420.00	470.00
BOD	BOD	6	81.50	66.55	10.00	150.00
B	B	6	0.13	0.05	0.10	0.20
BR	BR	2	0.65	0.07	0.60	0.70
TCOLIF	TCOLIF	3	93.33	72.59	16.00	160.00
CD	CD	6	0.01	0.00	0.01	0.01
CA	CA	6	99.50	24.48	66.00	120.00
CO3	CO3	6	17.67	26.20	1.00	58.00
CL	CL	6	10.83	1.17	10.00	13.00
CR	CR	6	0.02	0.00	0.02	0.02
COD	COD	6	18.17	24.73	1.00	50.00
CU	CU	6	0.02	0.00	0.02	0.02
DO	DO	6	7.07	2.16	3.30	9.80
DOC	DOC	0	.	.	.	.
LAS	LAS	0	.	.	.	.
F	F	6	0.45	0.05	0.40	0.50
HARD	HARD	6	586.67	90.48	410.00	670.00
FE	FE	6	0.02	0.01	0.02	0.03
KJN	KJN	6	0.28	0.45	0.10	1.20
PB	PB	6	0.02	0.00	0.02	0.02
LI	LI	6	0.05	0.00	0.05	0.05
MG	MG	6	76.17	8.82	59.00	84.00
MN	MN	6	0.02	0.00	0.02	0.02
HG	HG	6	0.00	0.00	0.00	0.00
MOLY	MOLY	6	0.01	0.00	0.01	0.01
NI	NI	6	0.02	0.00	0.02	0.02
NO3	NO3	6	1.55	0.44	0.80	2.00
OLGR	OLGR	6	4.83	4.45	1.00	10.00
S2O3	S2O3	0	.	.	.	.
PH	PH	6			6.70	8.10
K	K	6	2.23	1.31	1.10	4.60
RA	RA	2	1.50	0.71	1.00	2.00
BTR	BTR	3	7.00	5.20	1.00	10.00
RR	RR	0	.	.	.	.
SE	SE	6	0.01	0.00	0.01	0.01
AG	AG	6	0.01	0.00	0.01	0.01
NA	NA	6	118.33	7.53	110.00	130.00
TDS	TDS	6	933.33	17.51	910.00	960.00
SULS	SULS	0	.	.	.	.
SPC	SPC	6	1230.00	103.15	1080.00	1370.00
SR	SR	5	4.98	1.61	3.00	7.40
SO4	SO4	6	316.67	47.61	240.00	380.00
TEMP	TEMP	5	11.60	4.88	6.00	18.00
ZN	ZN	6	0.02	0.01	0.02	0.03
TOC	TOC	0	.	.	.	.
PHEN	PHEN	6	0.00	0.00	0.00	0.00
CYAN	CYAN	0	.	.	.	.
NH3	NH3	6	0.04	0.00	0.04	0.04

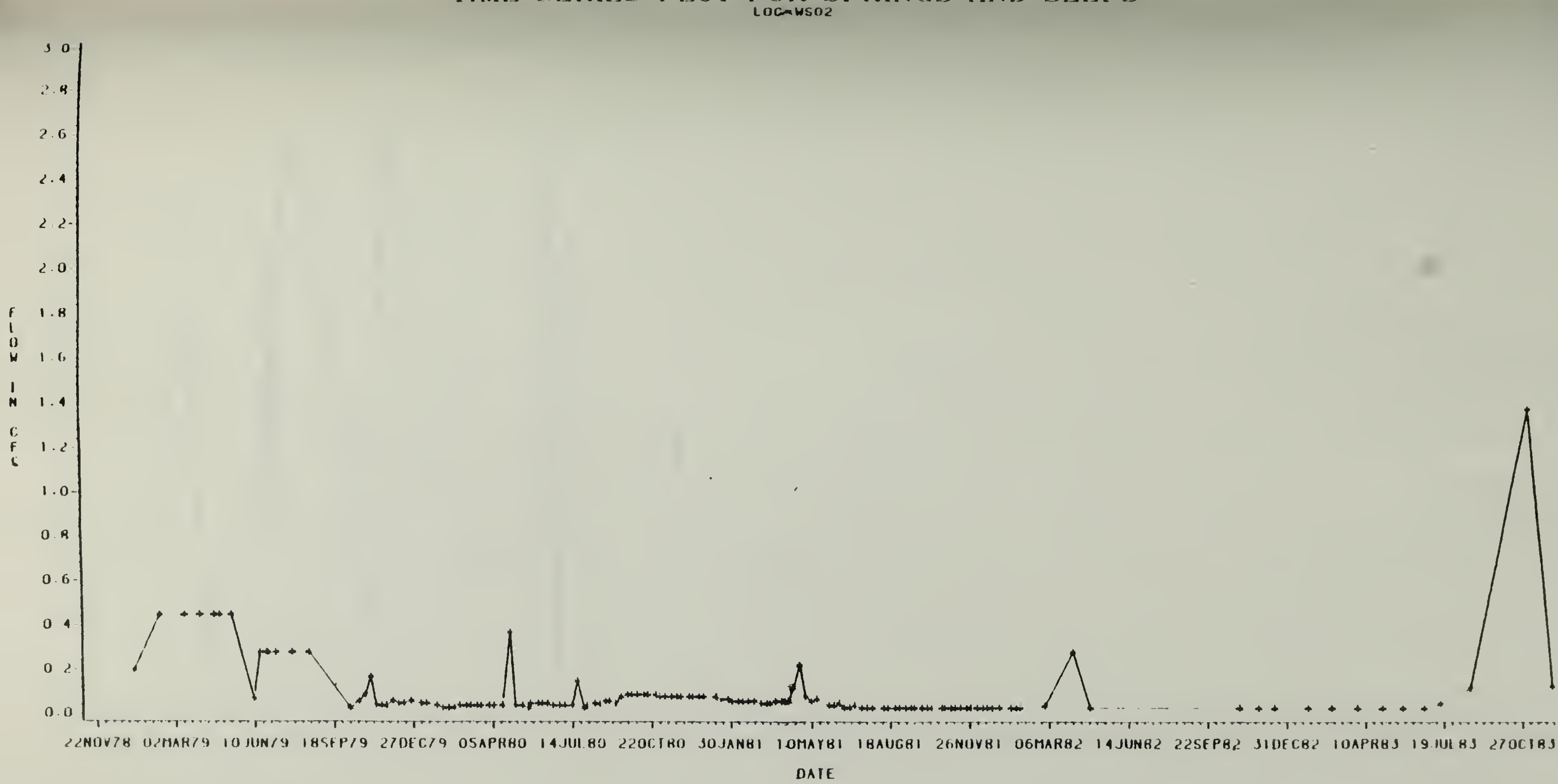
LOC=WS12

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TALK	TALK	6	618.33	104.00	470.00	730.00
AL	AL	6	0.10	0.00	0.10	0.10
ARS	ARS	6	0.02	0.00	0.02	0.02
FCOLIF	FCOLIF	3	147.33	253.40	1.00	440.00
BA	BA	6	0.50	0.00	0.50	0.50
HCO3	HCO3	6	583.33	85.01	470.00	660.00
BOD	BOD	6	113.67	110.43	10.00	300.00
B	B	6	0.37	0.10	0.20	0.50
BR	BR	2	0.30	0.28	0.10	0.50
TCOLIF	TCOLIF	3	169.67	256.66	18.00	466.00
CD	CD	6	0.01	0.00	0.01	0.01
CA	CA	6	83.17	14.37	57.00	100.00
CO3	CO3	6	34.67	37.06	1.00	100.00
CL	CL	6	11.08	1.28	9.50	13.00
CR	CR	6	0.02	0.00	0.02	0.02
COD	COD	6	22.67	22.57	1.00	50.00
CU	CU	6	0.02	0.00	0.02	0.02
DO	DO	6	7.22	2.35	2.80	9.40
DOC	DOC	0	.	.	.	.
LAS	LAS	0	.	.	.	.
F	F	6	2.05	1.83	0.50	5.30
HARD	HARD	6	500.00	89.22	360.00	630.00
FE	FE	6	0.02	0.00	0.02	0.02
KJN	KJN	6	0.17	0.12	0.10	0.40
PB	PB	6	0.02	0.00	0.02	0.02
LI	LI	6	0.05	0.00	0.05	0.05
MG	MG	6	69.00	10.83	52.00	81.00
MN	MN	6	0.02	0.00	0.02	0.02
HG	HG	6	0.00	0.00	0.00	0.00
MOLY	MOLY	6	0.02	0.00	0.01	0.02
NI	NI	6	0.02	0.00	0.02	0.02
NO3	NO3	6	4.40	1.32	3.00	6.10
OLGR	OLGR	6	5.00	3.90	2.00	10.00
S2O3	S2O3	0	.	.	.	.
PH	PH	6			7.30	8.20
K	K	6	3.30	1.34	1.90	5.80
HA	HA	3	4.67	1.15	4.00	6.00
SIR	SIR	2	8.00	0.00	8.00	8.00
RR	RR	1	0.20	.	0.20	0.20
SE	SE	6	0.01	0.00	0.01	0.01
AG	AG	6	0.01	0.00	0.01	0.01
NA	NA	6	203.33	59.55	120.00	260.00
TDS	TDS	6	1020.00	64.81	950.00	1100.00
SOLS	SOLS	0	.	.	.	.
SPC	SPC	6	1375.00	107.28	1220.00	1500.00
SR	SR	5	3.96	1.36	2.40	5.90
SO4	SO4	6	230.00	20.00	200.00	250.00
TEMP	TEMP	5	14.00	3.74	8.00	18.00
ZN	ZN	6	0.02	0.00	0.02	0.03
TOC	TOC	0	.	.	.	.
PHEN	PHEN	6	0.00	0.00	0.00	0.01
CYAN	CYAN	0	.	.	.	.
NH3	NH3	6	0.04	0.00	0.04	0.04

TIME SERIES PLOT FOR SPRINGS AND SEEPS

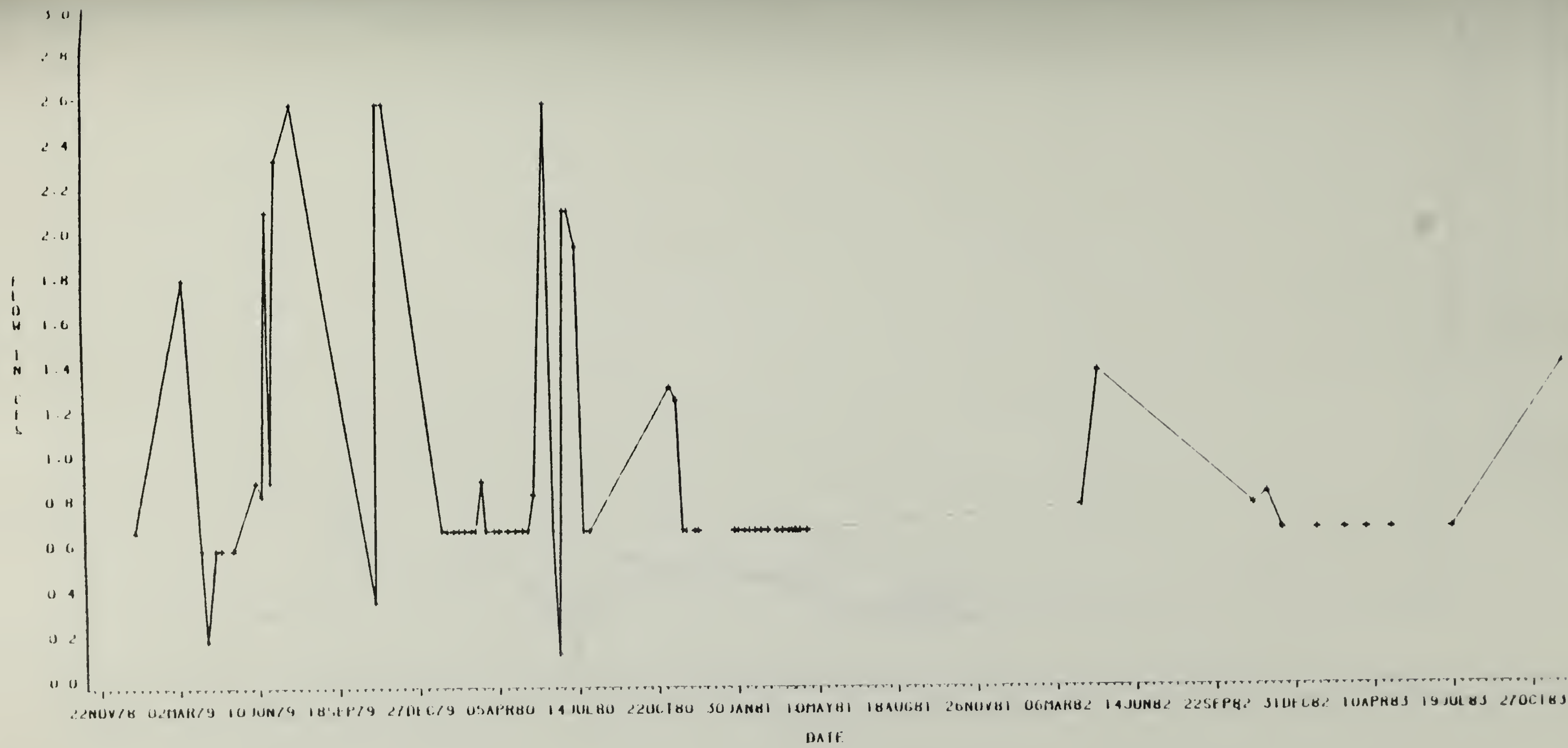
LOG-WS01

TIME SERIES PLOT FOR SPRINGS AND SEEPS



TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS03



TIME SERIES PLOT FOR SPRINGS AND SEEPS

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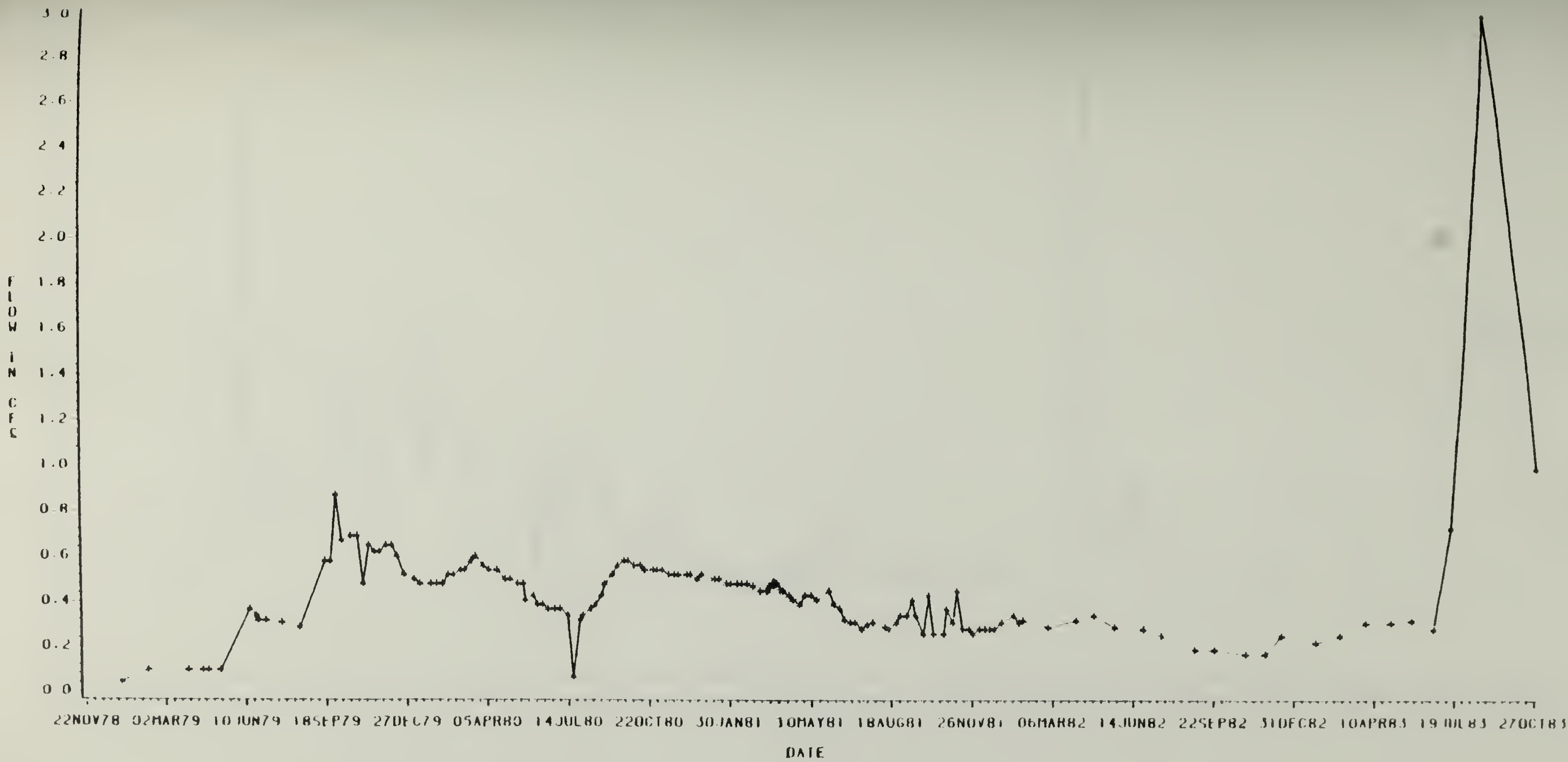
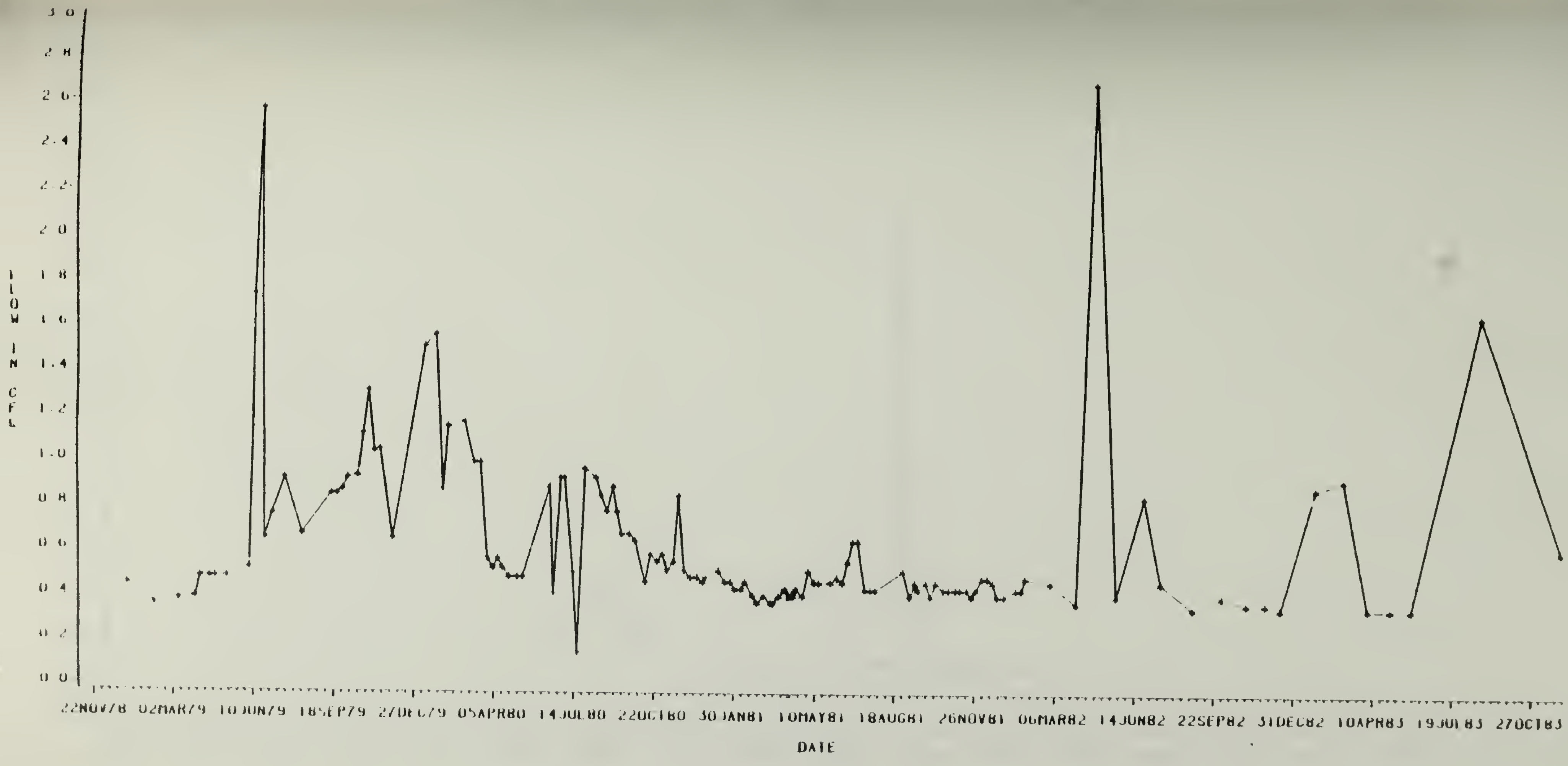


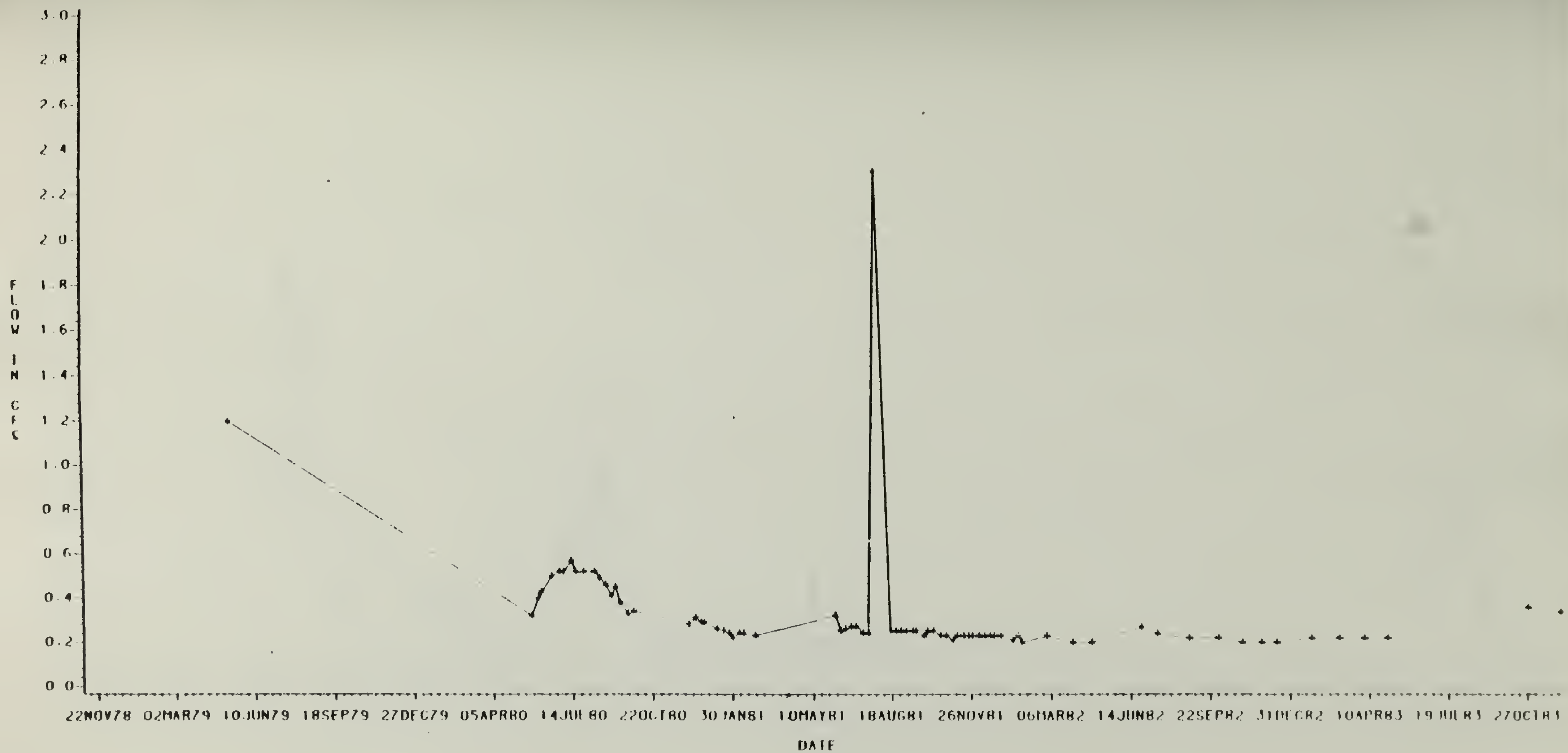
TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOG-WS06

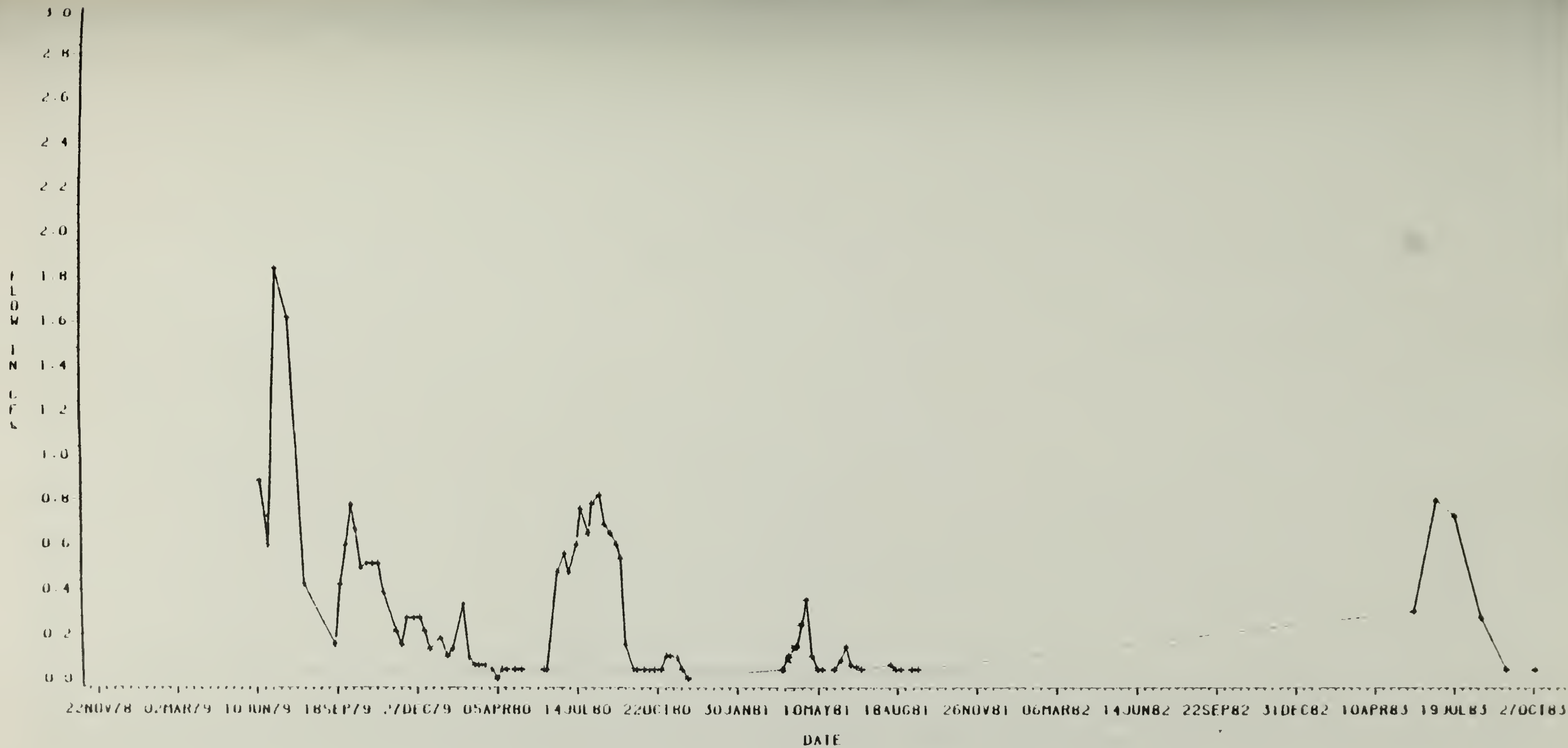


TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS07



TIME SERIES PLOT FOR SPRINGS AND SEEPS
LOC=WS08

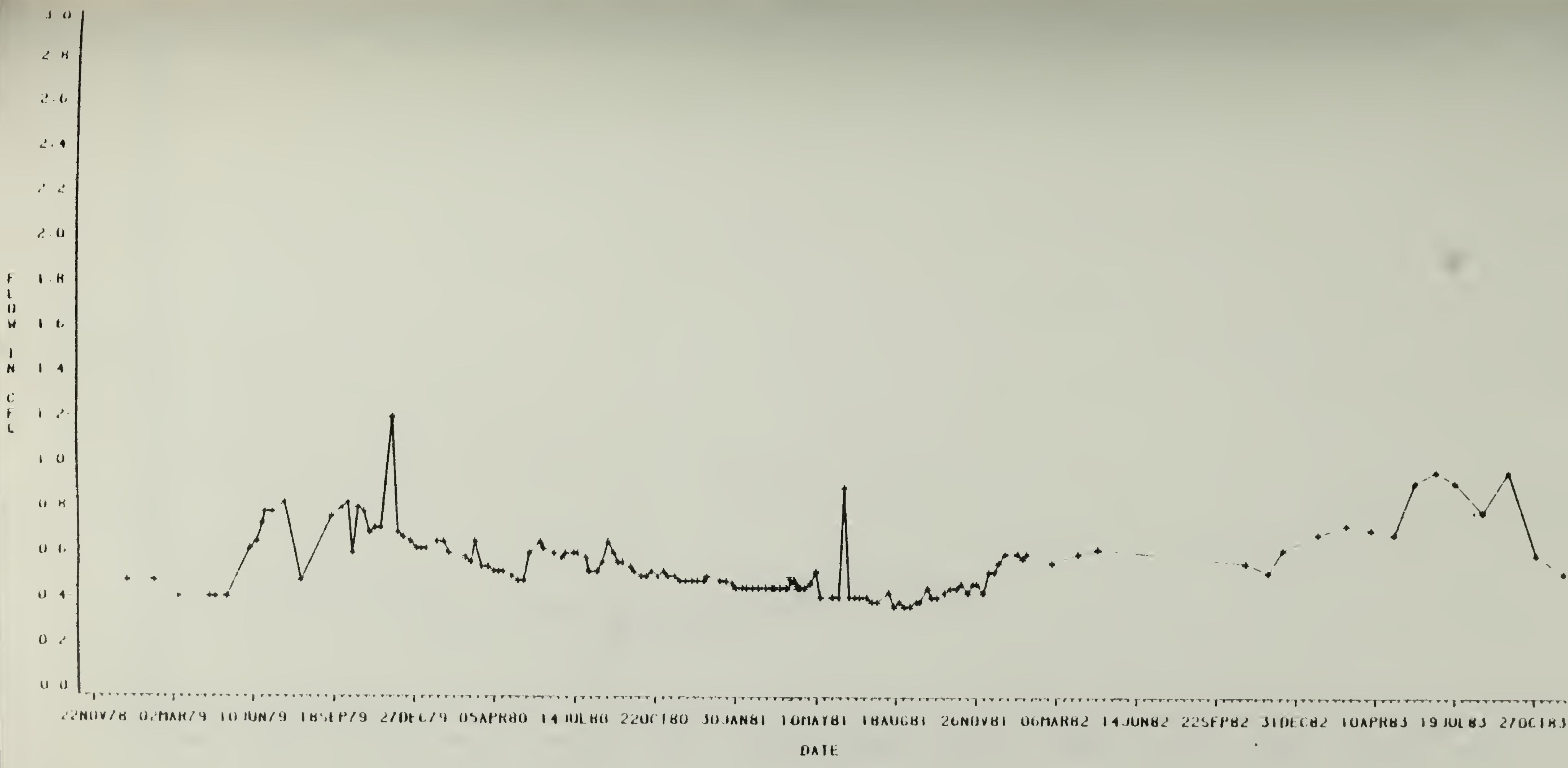


TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS09

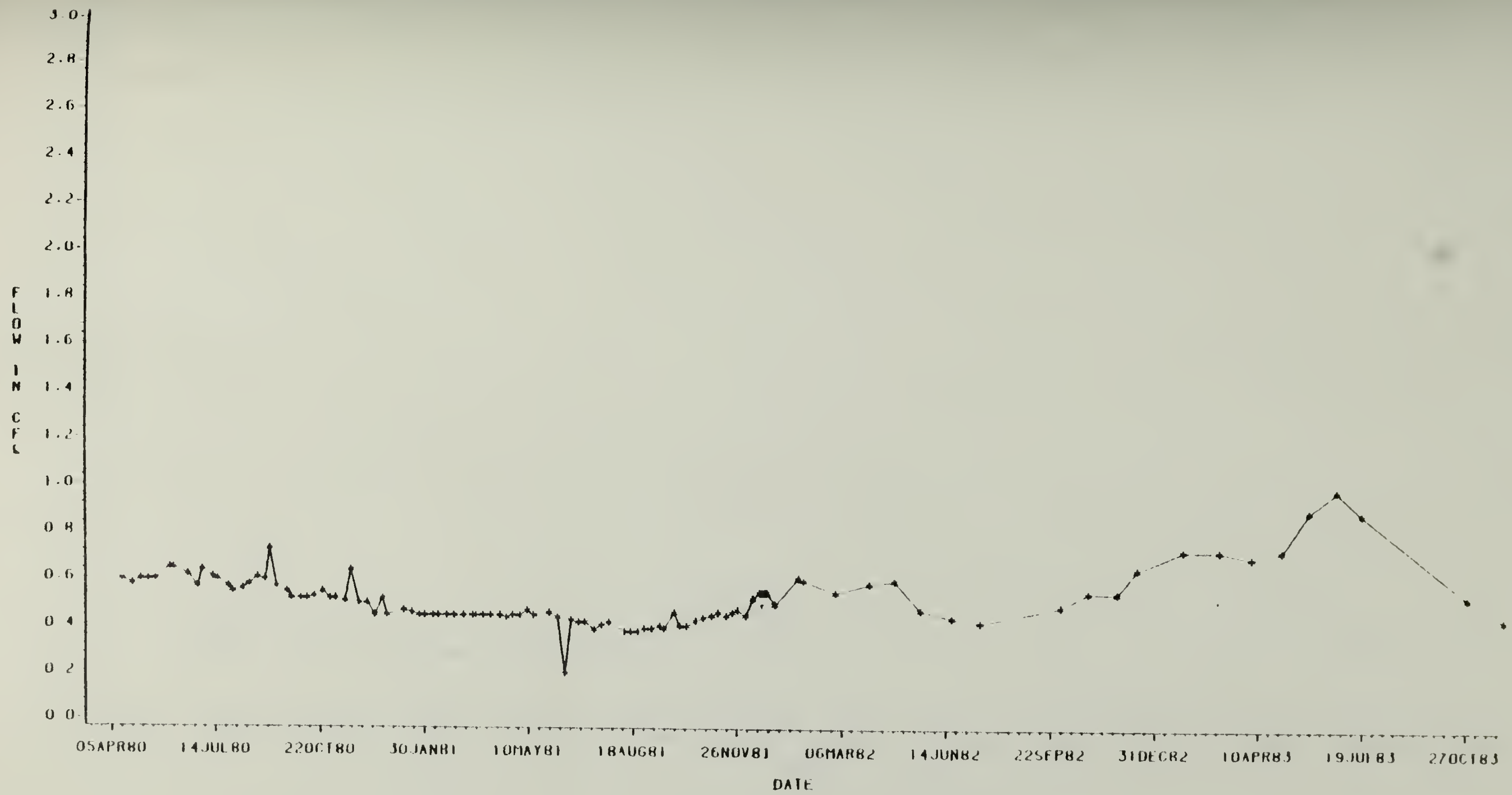
TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOCAWS10



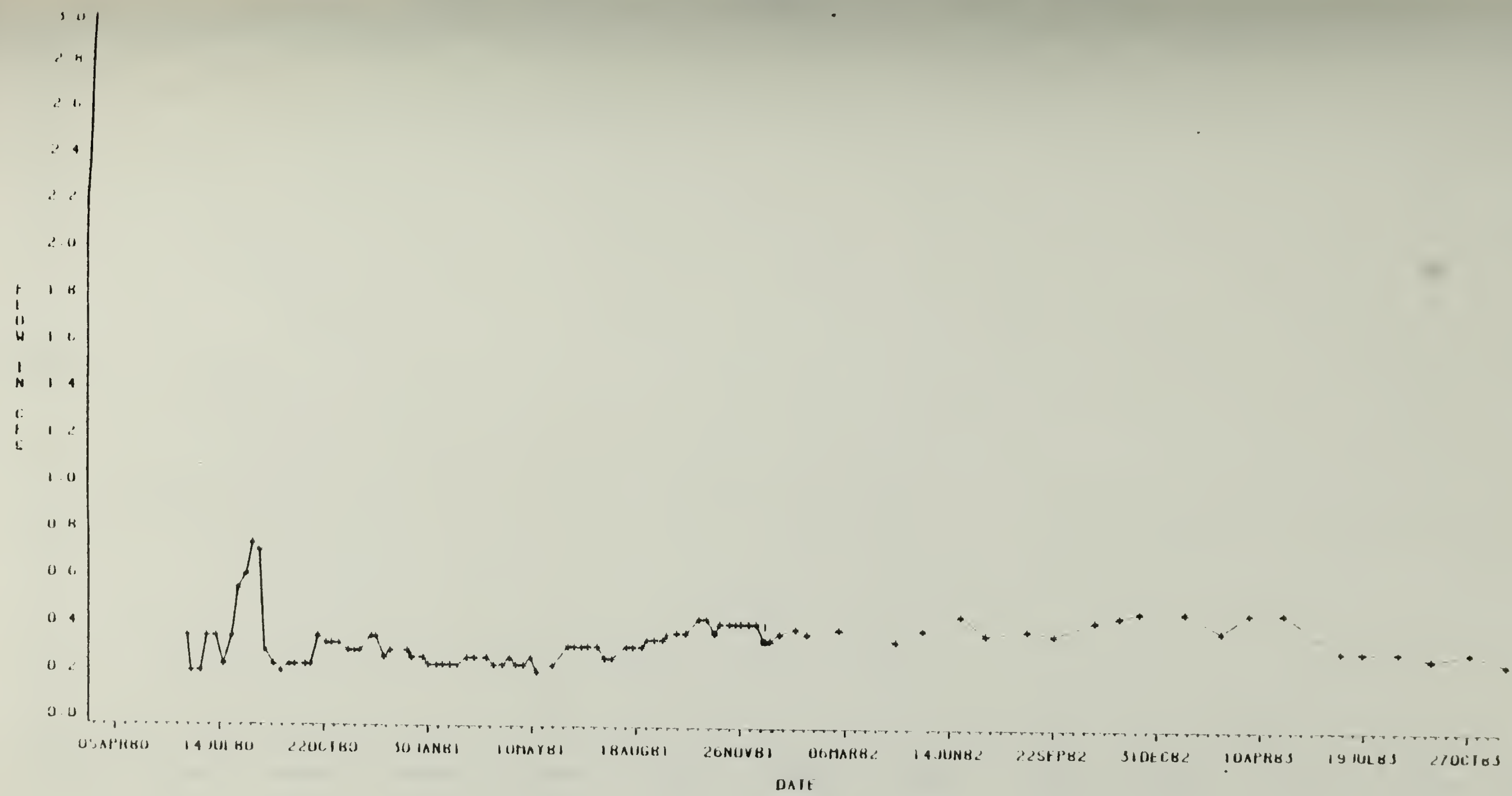
TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS11



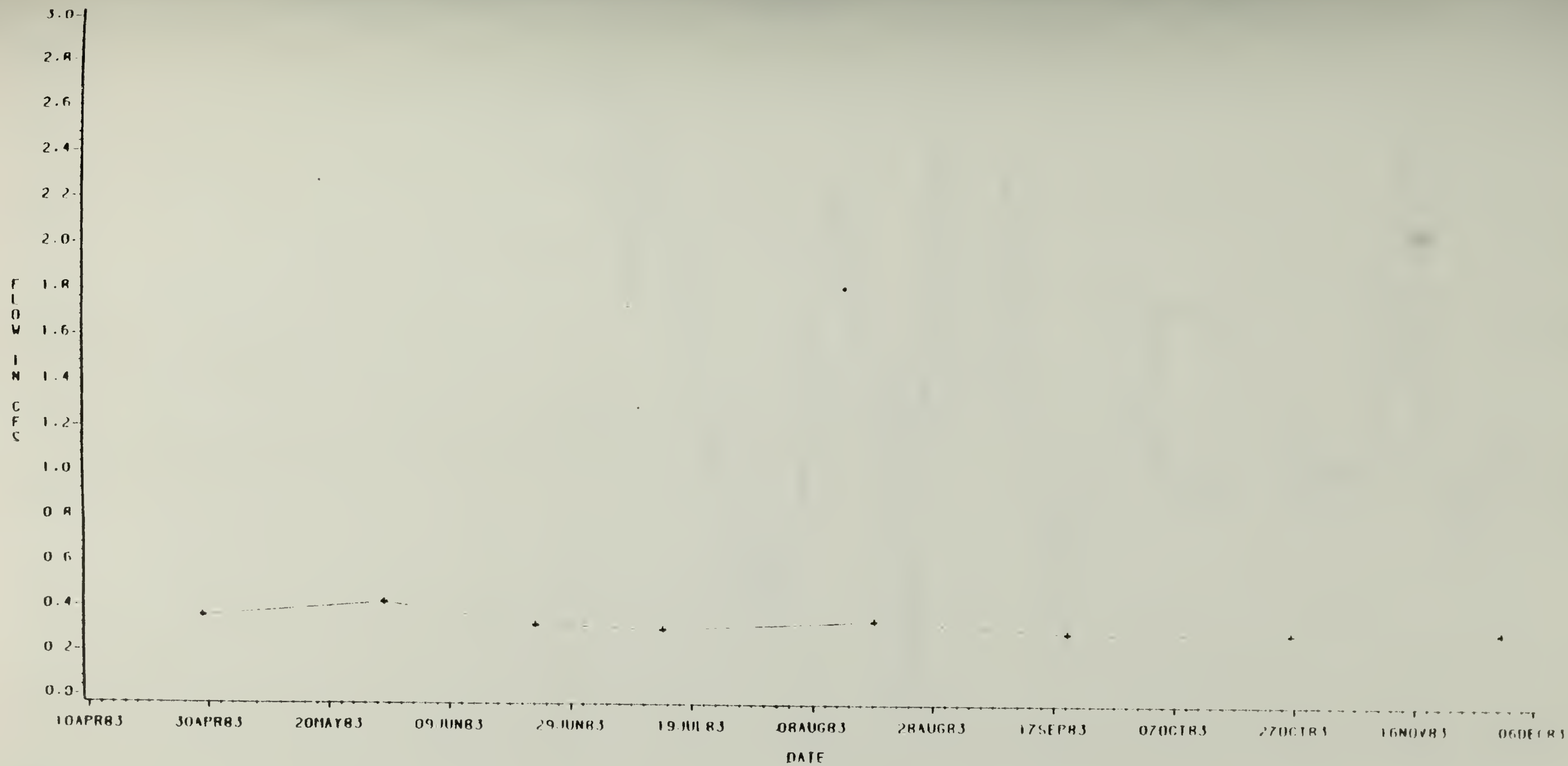
TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS12



TIME SERIES PLOT FOR SPRINGS AND SEEPS

LOC=WS13



TIME SERIES PLOT OF TEMPERATURE FOR SPRINGS AND SEEPS

LOC=WS01

TIME SERIES PLOT OF TEMPERATURE FOR SPRINGS AND SEEPS

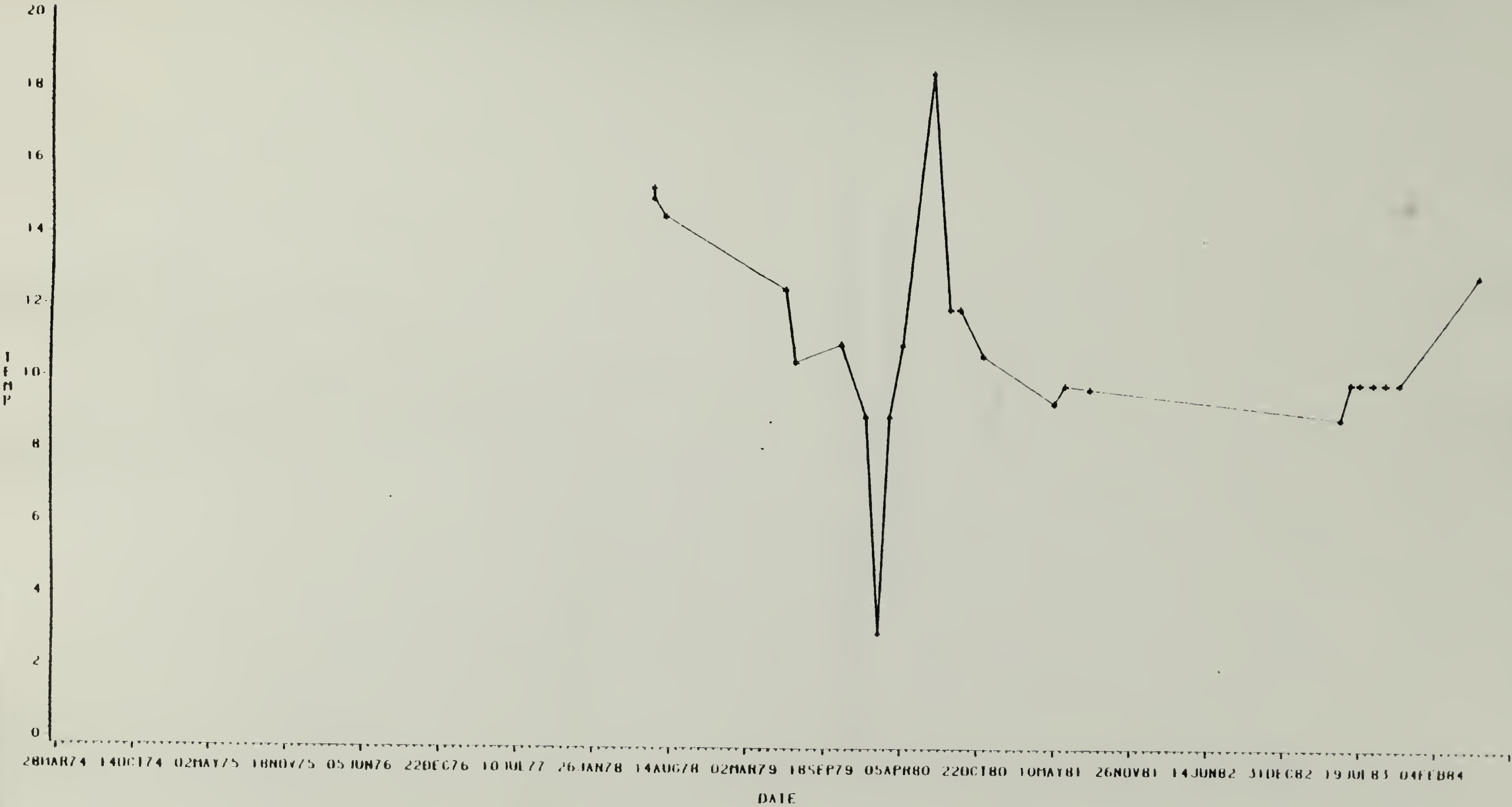
LOC=WS06

TIME SERIES PLOT OF TEMPERATURE FOR SPRINGS AND SEEPS

LOC=WS07

TIME SERIES PLOT OF TEMPERATURE FOR SPRINGS AND SEEPS

LOC=WS08



APPENDIX 6

Water Quality Analyses for

Alluvial Monitor Wells A-102-1, A-102-2 and A-102-4

INTER-OFFICE MEMORANDUM

TO: C. B. Bray
SUBJECT C.B. Water Analysis Report
SAMPLE NO.: B2231
LOCATION: A-102-1-4
CODE: BWA 21-1-4173-1-30

FROM: H. S. Skogen
PROJECT: CB
REPORT DATE: AUG. 1 4 1984
DATE RECEIVED: 6-22-84

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l		Tot.Alkalinity, mg/l as $CaCO_3$	*
Arsenic, mg/l		Bicarbonate, mg/l as $CaCO_3$	
Barium, mg/l		Carbonate, mg/l as $CaCO_3$	
Boron, mg/l		Bromide, mg/l	
Cadmium, mg/l		Chloride, mg/l	
Calcium, mg/l	63	Fluoride, mg/l	
Chromium, mg/l		Hardness (Ca+Mg), mg/l as $CaCO_3$	400
Copper, mg/l		Nitrogen:	
Iron, mg/l		Ammonia, mg/l as N	
Lead, mg/l		Kjeldahl, mg/l as N	
Lithium, mg/l	<0.05	Nitrate, mg/l	
Magnesium, mg/l	57	Nitrite, mg/l	
Manganese, mg/l	0.057	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l		BOD (5-day), mg/l	
Molybdenum, mg/l		COD, mg/l	
Nickel, mg/l		Oil and Grease, mg/l	
Potassium, mg/l	1.4	Phenols, mg/l	
Selenium, mg/l		Silica, mg/l	
Silver, mg/l		Tot.Dissolved Solids, mg/l	
Sodium, mg/l	250	Tot.Suspended Solids, mg/l	
Strontium, mg/l	2.2	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	
Zinc, mg/l	0.018	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t_s Phosphate, mg/l	
ALL ANALYSIS DONE BY ACCULABS			

RAA: cmh
t: Total <: Less than
cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel
rev: 7/17/84 *Includes hydroxyl alkalinity

INTER-OFFICE MEMORANDUM

TO: C. B. Bray
SUBJECT C.B. Water Analysis Report
SAMPLE NO.: B -2231
LOCATION: A-102-1-1
CODE: BWA 21-1-4173-1-30

FROM: H. S. Skogen
PROJECT: CB
REPORT DATE: JUL 27 1984
DATE RECEIVED: 6/22/84

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	700 *
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	650
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	1
Boron, mg/l	0.3	Bromide, mg/l	0.43
Cadmium, mg/l		Chloride, mg/l	16
Calcium, mg/l	*	Fluoride, mg/l	3.4
Chromium, mg/l	<0.02	Hardness (Ca+Mg), mg/l as $CaCO_3$	
Copper, mg/l	<0.02	Nitrogen:	
Iron, mg/l	<0.02	Ammonia, mg/l as N	<0.04
Lead, mg/l	<0.02	Kjeldahl, mg/l as N	<0.1
Lithium, mg/l	*	Nitrate, mg/l	<1
Magnesium, mg/l	*	Nitrite, mg/l	
Manganese, mg/l	*	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l t	<0.0002	BOD (5-day), mg/l	
Molybdenum, mg/l	0.06	COD, mg/l	<50
Nickel, mg/l		Oil and Grease, mg/l	<10
Potassium, mg/l	*	Phenols, mg/l	<0.01
Selenium, mg/l	<0.01	Silica, mg/l	20
Silver, mg/l		Tot.Dissolved Solids, mg/l	890
Sodium, mg/l	*	Tot.Suspended Solids, mg/l	
Strontium, mg/l	*	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	67
Zinc, mg/l	*	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	<1
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t_s Phosphate, mg/l	0.1
* SENT TO ACCULABS FOR ANALYSIS			

RAA: cmh t: Total <: Less than

cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel

rev: 7/17/84 *Includes hydroxyl alkalinity

INTER-OFFICE MEMORANDUM

TO:	C. B. Bray	FROM:	H. S. Skogen
SUBJECT	C.B. Water Analysis Report	PROJECT:	CB
SAMPLE NO.:	B 2233	REPORT DATE:	AUG. 14 1984
LOCATION:	A-102-2	DATE RECEIVED:	6-22-84
CODE:	BWA22-1-4174-1-30		

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l		Tot.Alkalinity, mg/l as $CaCO_3$	*
Arsenic, mg/l		Bicarbonate, mg/l as $CaCO_3$	
Barium, mg/l		Carbonate, mg/l as $CaCO_3$	
Boron, mg/l		Bromide, mg/l	
Cadmium, mg/l		Chloride, mg/l	
Calcium, mg/l	78	Fluoride, mg/l	
Chromium, mg/l		Hardness (Ca+Mg), mg/l as $CaCO_3$	500
Copper, mg/l		Nitrogen:	
Iron, mg/l		Ammonia, mg/l as N	
Lead, mg/l		Kjeldahl, mg/l as N	
Lithium, mg/l	<0.05	Nitrate, mg/l	
Magnesium, mg/l	72	Nitrite, mg/l	
Manganese, mg/l	0.097	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l		BOD (5-day), mg/l	
Molybdenum, mg/l		COD, mg/l	
Nickel, mg/l		Oil and Grease, mg/l	
Potassium, mg/l	1.3	Phenols, mg/l	
Selenium, mg/l		Silica, mg/l	
Silver, mg/l		Tot.Dissolved Solids, mg/l	
Sodium, mg/l	180	Tot.Suspended Solids, mg/l	
Strontium, mg/l	2.5	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	
Zinc, mg/l	0.009	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t_s Phosphate, mg/l	
ALL ANALYSIS DONE BY ACCULABS			

R4A: cmh — t: Total — <: Less than

cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel

rev: 7/17/84 — *Includes hydroxyl alkalinity

INTER-OFFICE MEMORANDUM

TO: C. B. Bray
SUBJECT C.B. Water Analysis Report
SAMPLE NO.: B-2233
LOCATION: A-102-2
CODE: BWA 22-1-4174-1-30

FROM: H. S. Skogen
PROJECT: CB
REPORT DATE: JUL 27 1984
DATE RECEIVED: 6/22/84

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	530 *
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	490
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	1
Boron, mg/l	0.2	Bromide, mg/l	0.57
Cadmium, mg/l		Chloride, mg/l	14
Calcium, mg/l	*	Fluoride, mg/l	0.7
Chromium, mg/l	<0.02	Hardness (Ca+Mg), mg/l as $CaCO_3$	
Copper, mg/l	<0.02	Nitrogen:	
Iron, mg/l	0.05	Ammonia, mg/l as N	<0.04
Lead, mg/l	<0.02	Kjeldahl, mg/l as N	<0.1
Lithium, mg/l	*	Nitrate, mg/l	<1
Magnesium, mg/l	*	Nitrite, mg/l	
Manganese, mg/l	*	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l t	<0.0002	BOD (5-day), mg/l	
Molybdenum, mg/l	004	COD, mg/l	<50
Nickel, mg/l		Oil and Grease, mg/l	<10
Potassium, mg/l	*	Phenols, mg/l	<0.01
Selenium, mg/l	<0.01	Silica, mg/l	17
Silver, mg/l		Tot.Dissolved Solids, mg/l	820
Sodium, mg/l	*	Tot.Suspended Solids, mg/l	
Strontium, mg/l	*	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	35
Zinc, mg/l	*	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	<1
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t, Phosphate, mg/l	0.1
* SENT TO ACCULABS FOR ANALYSIS			

RAA: cmh t: Total <: Less than

cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel

rev: 7/17/84 *Includes hydroxyl alkalinity

INTER-OFFICE MEMORANDUM

TO:	C. B. Bray	FROM:	H. S. Skogen
SUBJECT	C.B. Water Analysis Report	PROJECT:	CB
SAMPLE NO.:	B 2232	REPORT DATE:	AUG. 1 4 1984
LOCATION:	A-102-4	DATE RECEIVED:	6-22-84
CODE:	BWA 24-1-4173-1-30		

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l		Tot.Alkalinity, mg/l as $CaCO_3$	*
Arsenic, mg/l		Bicarbonate, mg/l as $CaCO_3$	
Barium, mg/l		Carbonate, mg/l as $CaCO_3$	
Boron, mg/l		Bromide, mg/l	
Cadmium, mg/l		Chloride, mg/l	
Calcium, mg/l	64	Fluoride, mg/l	
Chromium, mg/l		Hardness (Ca+Mg), mg/l as $CaCO_3$	410
Copper, mg/l		Nitrogen:	
Iron, mg/l		Ammonia, mg/l as N	
Lead, mg/l		Kjeldahl, mg/l as N	
Lithium, mg/l	<0.05	Nitrate, mg/l	
Magnesium, mg/l	60	Nitrite, mg/l	
Manganese, mg/l	0.010	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l		BOD (5-day), mg/l	
Molybdenum, mg/l		COD, mg/l	
Nickel, mg/l		Oil and Grease, mg/l	
Potassium, mg/l	1.2	Phenols, mg/l	
Selenium, mg/l		Silica, mg/l	
Silver, mg/l		Tot.Dissolved Solids, mg/l	
Sodium, mg/l	220	Tot.Suspended Solids, mg/l	
Strontium, mg/l	2.9	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	
Zinc, mg/l	0.018	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t_s Phosphate, mg/l	
ALL ANALYSIS DONE BY ACCULABS			

R4A: cmh t: Total <: Less than

cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel

rev: 7/17/84 *Includes hydroxyl alkalinity

INTER-OFFICE MEMORANDUM

TO:	C. B. Bray	FROM:	H. S. Skogen
SUBJECT	C.B. Water Analysis Report	PROJECT:	CB
SAMPLE NO.:	B-2232	REPORT DATE:	JUL 27 1984
LOCATION:	A-102-4	DATE RECEIVED:	6/22/84
CODE:	BWA24-1-4173-1-30		

PARAMETER/UNITS		PARAMETER/UNITS	
Aluminum, mg/l	<0.1	Tot.Alkalinity, mg/l as $CaCO_3$	630 *
Arsenic, mg/l	<0.02	Bicarbonate, mg/l as $CaCO_3$	590
Barium, mg/l	<0.5	Carbonate, mg/l as $CaCO_3$	1
Boron, mg/l	0.3	Bromide, mg/l	0.49
Cadmium, mg/l		Chloride, mg/l	13
Calcium, mg/l	*	Fluoride, mg/l	0.86
Chromium, mg/l	<0.02	Hardness (Ca+Mg), mg/l as $CaCO_3$	
Copper, mg/l	<0.02	Nitrogen:	
Iron, mg/l	0.33	Ammonia, mg/l as N	<0.04
Lead, mg/l	<0.02	Kjeldahl, mg/l as N	<0.1
Lithium, mg/l	*	Nitrate, mg/l	<1
Magnesium, mg/l	*	Nitrite, mg/l	
Manganese, mg/l	*	Nitrate + Nitrite, mg/l as N	
Mercury, mg/l t	<0.0002	BOD (5-day), mg/l	
Molybdenum, mg/l	0.05	COD, mg/l	<50
Nickel, mg/l		Oil and Grease, mg/l	<10
Potassium, mg/l	*	Phenols, mg/l	<0.01
Selenium, mg/l	<0.01	Silica, mg/l	19
Silver, mg/l		Tot.Dissolved Solids, mg/l	830
Sodium, mg/l	*	Tot.Suspended Solids, mg/l	
Strontium, mg/l	*	Sulfur:	
Vanadium, mg/l		Sulfate, mg/l	60
Zinc, mg/l	*	Sulfide, mg/l	
Gallium, mg/l		Thiocyanate, mg/l	
Germanium, mg/l		Dissolved Organic Carbon, mg/l	<1
Titanium, mg/l		Total Coliform, colony/100 ml	
Zirconium, mg/l		Fecal Coliform, colony/100 ml	
		t_s Phosphate, mg/l	0.2
* SENT TO ACCULABS FOR ANALYSIS			

RAA: cmh — t: Total — <: Less than

cc: G. Fosdick, G. Ullinskey, CB Central Records, M. Chappel

rev: 7/17/84 — *Includes hydroxyl alkalinity